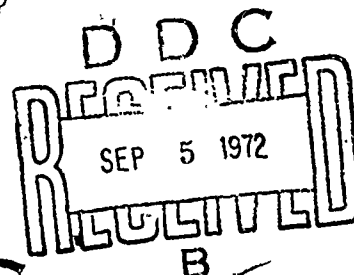


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NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

CONSIDERATIONS OF RETURN ON CAPITAL
INVESTMENT AND PAYMENT ON PROGRESS IN THE
DEFENSE SHIPBUILDING INDUSTRY

by

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June 1972

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and Payment on Progress in the
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I. BACKGROUND

A. INTRODUCTION

In developing the background for this thesis it is appropriate to first discuss the basis for its development. The most recent impetus on return on capital investment and payments on progress for the defense shipbuilding industry came from the Report of the Industry Advisory Council (IAC) Subcommittee to Consider Defense Industry Contract Financing, published 11 June 1971 by the Department of Defense.⁽¹⁾ This report, although not the first in the area, was used as the starting point for this thesis. The IAC report is based upon data of the aerospace industry, and its recommendations were directed at contracting relationships and procedures used within that industry. The Subcommittee recommended further study on contracts involving payments on physical progress, a procedure used primarily within the defense construction and shipbuilding industries. In response, the Navy formed a task group to study progress payments within the shipbuilding industry. The report of that task group has been used for the development of this thesis.⁽²⁾

As stated in the IAC report, progress payments and cost reimbursements are an important source of contractor financing. The long lead times for procurement of materials and subsystems and the heavy investment in engineering and

production prior to the delivery of the first contract and item makes these payments a necessary part of contracting. The premise is also stated that the use by the contractor of this one form of financing would save the government money, since financing the contract entirely by private sources would greatly increase the system costs. There is also a question as to whether or not the required amount of commercial credit would be available.⁽³⁾

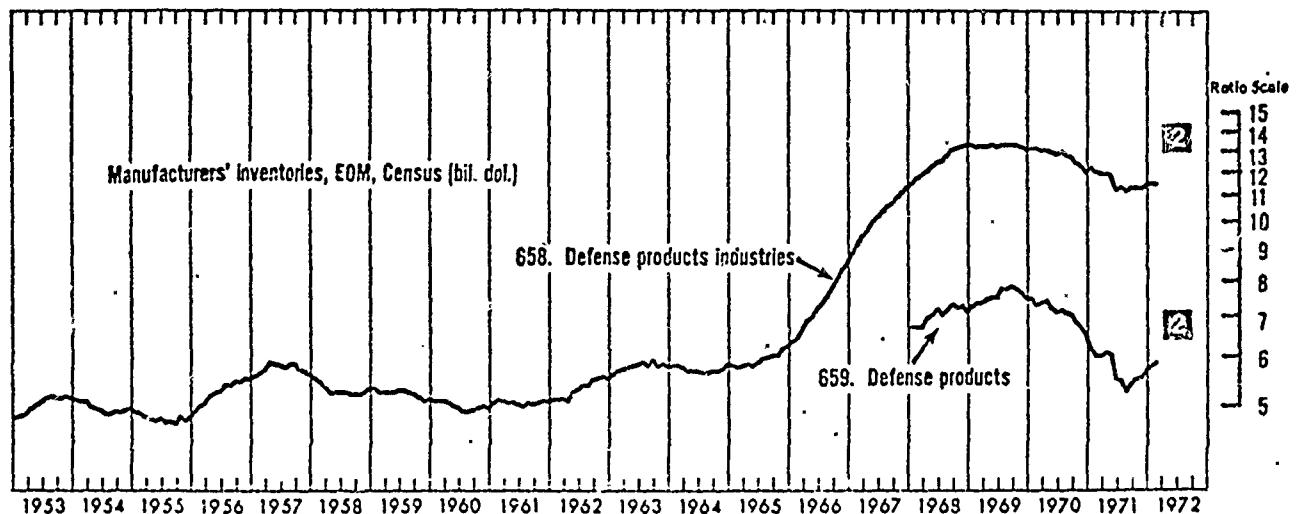


Figure 1.

As can be seen in Figure 1, over the past several years there has been a continuing increase in the inventory levels that are maintained by defense contractors to meet their business commitments. This has caused in turn a sharp increase in short term funds requirements that have been met by increased levels of government financing, bank loans, and prime contractor's accounts payable. In addition to the

increasing inventory levels, there has been a sharp increase in the dollar amount of progress payments outstanding. Figure 2⁽⁴⁾ displays this increase. The IAC Subcommittee states that this increase is directly related to the growth in demand for pre-delivery financing of defense work.

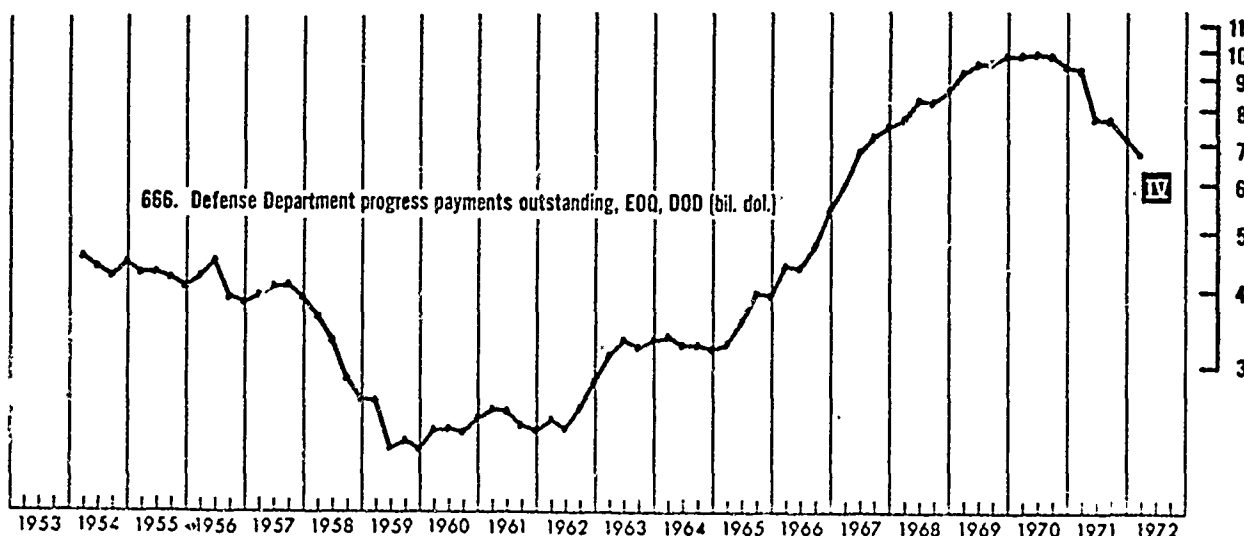


Figure 2.

Coupled with the progress payment problems is the profit policy which the government used. The two are interrelated in the following discussion.

(1) If progress payments decrease, interest* from private source financing increases and contractors' realized profits will decrease.

Profit policy affects the ability of contractors to increase their equity capital and, consequently, their long-range capacity to finance defense work.

* Under the present ASPR Regulations interest is not an allowable expense. The problem of whether or not interest charges should be allowable is not considered in this thesis. The matter is discussed at great length in the IAC Subcommittee Report Appendix H and J.

Regarding profit policy, the Department of Defense has long been interested in the employment of the contractor's return on invested capital in the establishment of profit negotiation objectives in non-competitive procurements. However, as of this date, a workable policy has not been promulgated. An attempt was made in the early 1960's during the development of the Weighted Guidelines Method but was abandoned because of the difficulty in apportioning a contractor's total investment in facilities and operating capital to specific contracts.⁽⁵⁾ The need to revise the profit policy has become increasingly more apparent as money has grown tighter. Contractors are becoming more aware of how their available dollars are invested and where they are earning their highest return for the investment of those dollars. In most cases, the return in the commercial sector is superior to that earned in the defense sector.

(2) The other side of the profit policy picture is the desire of DOD for contractors to invest in their own facilities and not require use of Government facilities to perform a contract. Theoretically, one of the policy objectives of the Weighted Guidelines is to "discourage contractors from relying on Government resources."⁽⁵⁾ The Armed Services Procurement Regulation "Manual for Contract Pricing, under Weighted Guidelines, Selected Factor-Source of Resources" states "The idea behind this factor is to

encourage the contractor to acquire and use his own plant and equipment, and to locate and use his own financial sources. The contractor's dependence on financial assistance in the form of facilities must be considered." ⁽⁶⁾ As explained in the "Manual for Contract Pricing," "if the contractor fulfills our objectives and uses his own resources in the performance of a contract, the assigned weight for this factor is 0." Therefore, how could there be any incentive for the contractor to provide facilities in the performance of a contract? Of course, the problem is more complex, but the point is that no positive incentive exists for contractors' investments.

Various schemes have been attempted or studied prior to the IAC method which is discussed later in this thesis. The underlying idea most of the procedures use is to weight the impact from both the normal weighted guidelines method and the return on investment approach. Over the years, the various weights have ranged from seventy percent on weighted guidelines and thirty percent on investment, to the IAC Subcommittee recommendation of fifty percent for both. Within the investment portion, the weights have varied from a ratio of two to one for facilities against operating capital and equipment, to two to one for operating capital and equipment against facilities. (There are currently under consideration two proposed changes to the Armed Services Procurement Regulations, both incorporating

changes to the profit determination procedures. These are discussed in Chapter III.)

B. DEFINITIONS

Before proceeding further, it is important that the basic premises and terms used in this thesis be defined.

1. Time Adjusted Return on Investment: the maximum rate of interest that could be paid for the capital employed over the life of an investment without loss on the project.⁽⁷⁾ In terms of the model described in Chapter V, Rate of Return is defined as the discount rate that makes the present value of a project equal to the cost of the project.⁽⁸⁾

2. Capital Invested as a Basis for Return on Investment: the book value of the total capital employed in fulfilling a contract, weighted for risk and motivation. There are other definitions which are certainly pertinent and are described here for future reference information. The Logistics Management Institute defines capital invested as equity capital plus long-term debt. The Government Accounting Office expresses it as "capital in all investments whether financed by current liabilities, long-term debt, equity capital, or other items on the liability and capital side of the balance sheet." The Air Force Finance Contracting Model (discussed later) uses investment as the work in process of a contractor on a specific contract.

3. Profit on Capital: the term used to express the combination of profit on cost and investment, as computed

in a defense contract.⁽⁹⁾ A fifty percent weight is assigned to the profit on cost and a fifty percent weight on the capital invested (see preceding definition).

C. THE 1970 INDUSTRY ADVISORY COUNCIL SUBCOMMITTEE

The Industry Advisory Council Subcommittee was chartered on 3 November 1970 to consider Defense Industry Contract Financing with J. Ronald Fox, ASA(I&L) as chairman, to study and make recommendations to the Secretary of Defense on the following topics:

(1) The determination of a fair and equitable relationship between the Department and contractor concerning the division of financing responsibility.

(2) Current defense contract financing procedures as they relate to rates of progress payments, frequency of payment and standards of eligibility.

(3) Current procedures whereby reimbursement under cost type contracts includes incurred but unpaid costs.

(4) An assessment of the merits of using cash disbursements rather than accrued liabilities as the basis of Government financing on the supplier/subcontract portions of defense contracts.

(5) A review of related Defense policies such as profit policy, allowability of interest costs, and others, which might require change to better accommodate a change in financing policy, including an assessment of the estimated cost to the government of such changes.

(6) An assessment of the availability of private financing for defense contractors.⁽¹⁰⁾

1. The Air Force Contract Financing Model

Among the tools used by the IAC Subcommittee in developing their findings, was a contract financing model of the Air Force called FINMOD. This is a computer model which attempts to quantify the contributions of each source of contract financing under various financing arrangements. It is capable of giving a comprehensive cash flow analysis based on inputs identical to the parameters of cash transactions which take place in actual contracts. The Air Force Contract Financing Model (FINMOD)* simulates daily sources and applications of funds during the entire life cycle of a contract. The model has been designed to accept as inputs all of the known constraints and variables which influence contractor cash flows. It is important to note that the Air Force model does not measure the total investment of a contractor but only the amount of the investment in work-in-process.

The work-in-process of a prime contractor is financed by the following sources as assumed by the model:

- (a) Prime contractor's cash investment
- (b) Government progress payments or cost reimbursements
- (c) Accrued wages and salaries

* See Appendix C, Figure 19.

- (d) Accounts payable to vendors and subcontractors
- (e) Bank float on checks written but not yet charged against the contractor

In all, the IAC Subcommittee collected data on 166 contracts and analyzed the 95 fixed price contracts that were included. The most significant observations were these:

- (a) Substantial inequities existed in the level of financing provided by prime contractors compared to subcontractors.

- (b) No standard exists for the uniform treatment of payment frequency and payment delay.

- (c) Substantial inequities exist in the level of government financing provided to large versus small contractors, and the frequency of progress payments varies directly with contract size.

2. Level of Cash Investment

In terms of the different cash investment levels of the contractors, the IAC Subcommittee stated that one approach to eliminating these differences would be to standardize all financing variables and adjust the rate of payment to achieve a desired level of government investment. The basic guidance for this is stated below as it comes from the IAC Report:

"Before considering what progress payment rate should be established, it may be useful to recall three reasons why the Department of Defense provides assistance in the form of progress payments: (1) Without progress payments, the contractor's required investment in working capital would become excessive for large defense contracts with a long preproduction period:

(2) without progress payment financing, substantial fluctuations in the volume of defense sales of any given contractor would make it difficult and costly for him continually to adjust his capital structure or borrowing to cover peak financing requirements; and (3) the government is able to borrow capital at a lower cost than private industry. The lower cost of government borrowing has been advanced in support of arguments that the government's investment in any defense contract should be as large as possible."*

Since this study has been completed, a method has been proposed in the two studies on profit policy that consider both investment and risk. Both proposals recommend a procedure that adjusts the profit for Contract Capital associated with the contract type and risk. This is discussed in detail in Chapter III.

3. IAC Recommendations and Implementations

The final report to the Secretary of Defense was completed 11 June 1971. Among the recommendations were the following:

(a) Usual progress payments and cost reimbursements for all contractors, except small businesses, will be made bi-weekly at a rate of eighty percent for progress payments, 100 percent for cost reimbursements on the actual disbursements made during the contract. Cost reimbursements and progress payments for in-house costs will be paid on the basis of costs incurred during the contract.

* DOD Report of the Industry Advisory Council Subcommittee to Consider Defense Industry Contract Financing, 11 June 1971, p. 18.

(b) Profit should be determined with a fifty percent weight on the weighted guidelines based on cost and fifty percent on the capital employed. The standard return on capital is defined as a four year average of the profits before interest and taxes on the total equity and debt of the FTC-SEC commercial sample. A detailed discussion regarding the IAC Subcommittee's recommendations for Profit on Capital is contained in Chapter III.

The Subcommittee also recommended that further study be conducted for progress payments, based on a percentage or stage-of-completion, in particular to contracts for shipbuilding or ship conversion, alteration, or repair inasmuch as these are the only types of contracts on which pre-delivery payments are based on a percentage of completion.

The recommendations of the IAC Report were endorsed, and accordingly, DPC 94 and 96 were promulgated. These made interim changes to the ASPR sections regarding progress payments and cost reimbursement. In effect ASPR now states that progress payments will be made no more frequently than bi-weekly and will only be made on eighty percent of the actual disbursements of the contractor. Shipbuilding, repair, and alteration to ships were, however, excluded from this revised clause.

The Profit on Capital approach is still under study, and although two different methods have been developed, a standardized procedure has not yet been promulgated.

D. THE NAVY TASK GROUP

Following the Subcommittee's recommendations for an in-depth study on progress payments based on a percentage of completion, the Assistant Secretary of the Navy (FM) and Assistant Secretary of the Navy (I&L) established the Task Group to Study Shipbuilding Progress Payments on August 3, 1971.

As defined, the Task Group's study entailed the following:

- (1) Collection of statistical data
- (2) Collection of cost data
- (3) Documentation of procedures and practices
- (4) Analysis and evaluation of data
- (5) Preparation of a written report, including impact of any recommended changes.

Using the progress payment philosophy and guidelines of the IAC Subcommittee as stated above, the Task Group to Study Shipbuilding Progress Payments, with the assistance of FINMOD, has developed a procedure for payment based on progress in the Defense Shipbuilding Industry.

The Task Group investigation revealed that the present method of determining physical progress as the guide for progress payments is inadequate and has recommended that an alternative be used. To summarize, the Task Group recommended that progress payments be paid as prescribed in ASPR (modified by DPC 94 and 96). In addition, the Task Group recommended that interim payments be made as a means

of liquidating the progress payments. To incorporate these into the progress payment scheme, the interim payments should be made when progress payments are equal to a pre-determined percentage of contract price. The exact amount of the interim payment is a function of the length of the contract in years and the total payments to date. In contracts that provide for the delivery of more than one vessel or component that is individually priced, such as software, an additional interim payment will be made upon the preliminary acceptance of each vessel or component. This payment is a fixed percentage of contract price and directly related to overall interim payments discussed above.

The interim payments will not be made unless the demonstrated performance on the physical progress of the contract at the time of eligibility is at a predescribed percentage of the contract completion. This is the link between the contract cost and physical progress. If the Supervisor of Shipbuilding, Conversion, and Repair determines that the physical completion is not at the predescribed level, the interim payment will not be made until that level is reached. There is also a reserve for performance for the purpose of meeting the cost of finishing unfinished work or correcting defects which is the percentage difference between the indicated percentage of completion of the contract price and the payments that are made. A detailed discussion, including the exact percentages and examples, is developed in Chapter IV.

II. SHIPBUILDING INDUSTRY PROFIT AND INVESTMENT

A. INVESTMENT AND COST POST WORLD WAR II

1. Worldwide Shipbuilding

The World War II industrial mobilization had a major impact on the United States shipbuilding industry. To provide the great number of ships that were required to move troops and supplies and fight the war, substantial investments were made to modernize facilities, and new techniques were adapted that produced ships in an assembly line or series basis. To permit standardization and efficiency, different shipyards specialized in a particular type ship which, when coupled with the series operation, provided the required ships at a relatively low cost. So successful was the effort, that President Truman declared at the close of the War, "the shipbuilding accomplishments of the United States not only astonished the world but more important than that, defeated the enemy." The end of the war, however, brought about a shift in emphasis within the country, and the importance of shipbuilding became obscured by other events. Nevertheless, the importance of efficient and competent shipbuilding and ship repair capability to seapower's role in the national defense has not diminished. Modern Naval vessels are still required from a military standpoint and merchant shipping remains an important part of the national economy.

In the shipbuilding industry there are two terms, capacity and capability, which because of their distinct differences, require definition. Capacity is identified with and measured by the physical assets of a company, such as shipyards, equipment or machinery. Capability on the other hand, is comprised of human and economic factors that determine the potential of these physical assets. "Among the determinates of a nation's shipbuilding capability are its national objectives and policies, its economic and labor conditions, its state of scientific and technological development, and its shipbuilding experience. While capacity and capability are interdependent in the shipbuilding industry, they are not identical."⁽¹¹⁾

The dominant warship building nations in the modern world are the United States and the Soviet Union. Each produces more than twice the output of all the rest of the world.⁽¹²⁾ At the same time, these two countries are minor producers in merchant shipbuilding, where Japan dominates the world market in both number of ships and in total tonnage. Figure 3 clearly shows Japan's superiority. A world shipbuilding survey of merchant vessels 1000 tons or over, conducted in July 1971, showed that the United States had sixty vessels of 1,484,600 gross tons either under construction or on order as compared to Japan who had 866 vessels of 39,528,000 gross tons.⁽¹³⁾ Approximately sixty-six percent of all shipbuilding and repair in the United States is Naval work.

AVERAGE MERCHANT SHIP TONNAGE*

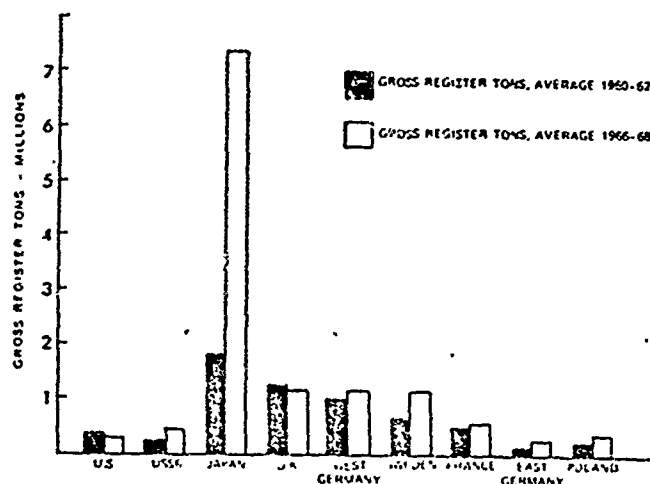


Figure 3.

*House Armed Services Committee Report Number 91-71, p. 9989.

In terms of capacity, as defined earlier, Japan has the physical assets necessary to build a large number of ships and very large ships, but since they have not built complex ships such as aircraft carriers for many years, they presently do not have the capability.

2. Nature of the Industry

Shipbuilding is an assembly type industry similar in many ways to the automobile industry. But, just as there are similarities in the procedures, there are differences created by the complexities of shipbuilding that set it apart from other assembly industries. Most assembly industries produce a large number of relatively low cost units. Shipbuilding produces a small number of high cost units. The industry is very labor intensive with forty to fifty percent of the total shipyard cost in labor and

and overhead.⁽¹⁴⁾ For example, the cost breakdown of a \$12,000,000 cargo ship built in the United States in 1966 was as follows:⁽¹⁵⁾

	<u>Base Ship Cost</u>	<u>Percent</u>
Steel	\$ 900,000	7.5
Other Material	5,600,000	47.5
Labor	4,600,000	37.5
Overhead	900,000	7.5
	<hr/>	<hr/>
TOTAL	\$12,000,000	100.0

Of the other material item, \$2,560,000 or about 24 percent was externally manufactured and not produced in the prime shipyard.

Even in the highly automated Japanese shipyards labor plays a major role in shipbuilding. As stated by an officer of one of Japan's largest shipbuilding companies, "The shipbuilding industry involves a great deal of manual labor. It is a hard-work industry and there is a trend on the part of young people to dislike manual labor." This general reluctance of Japanese workers to get involved in the labor of shipbuilding, combined with technical problems that make it difficult to achieve complete automation, has caused labor costs to continually rise.⁽¹⁶⁾

Total employment in the United States' private shipyards has remained fairly constant over the past few years (although there have been large fluctuations in various regions of the country). Employment in Naval shipyards has varied more than in the private shipyards, but there have not been the large regional fluctuations, see Table II.

TABLE I.*

(In Thousands of Men)

<u>Year</u>	<u>Private Shipyards</u>	<u>Naval Shipyards</u>
1965	128.9	83.8
1966	143.6	85.4
1967	140.0	94.5
1968	141.0	95.2
1969	142.0	91.0
1970	132.4	83.0
1971 (11 months)	129.0	75.6

*Bureau of Labor Statistics November 1971.

The regional changes are very dramatic in the Pacific and North Atlantic:

TABLE II.*

Regional Shipyard Employment
(In thousands of Men)

<u>Year</u>	<u>Private S. Y. Pacific</u>	<u>Naval S. Y. Pacific</u>	<u>Private S. Y. N. Atlantic</u>	<u>Naval S. Y. N. Atlantic</u>
1965	14.5	17.4	48.0	28.9
1966	20.7	19.3	52.6	25.5
1967	20.7	21.5	84.4	27.8
1968	22.5	21.7	46.2	28.5
1969	25.2	20.6	45.8	27.6
1970	20.3	19.1	43.8	24.4
1971(11 mos.)	16.1	18.5	40.7	20.8

*Bureau of Labor Statistics November 1971.

Table III lists the 1969 Total Shipbuilding and Repair Labor Force of six major shipbuilding nations:

TABLE III.**

1969 Total Shipbuilding and Repair Employment*
(In thousands of Men)

<u>Country</u>	<u>Shipbuilding</u>		<u>Repair</u>		<u>Total.</u>
	<u>Naval</u>	<u>Merchant</u>	<u>Naval</u>	<u>Merchant</u>	
Sweden	2	22	1	7	32
France	31	20	9	10	70
West Germany	13	47	6	15	81
Japan	3	121	5	18	147
United Kingdom	17	63	35	50	165
United States	86	29	88	31	234
TOTAL	152	302	144	131	729

*Includes Naval Shipyards

**House Armed Services Committee Report Number 91-71, p. 9990.

From a comparison of Tables I and III it can be seen that the total private shipyard employment of the United States and Japan was approximately equal in 1969. With the United States' shipbuilders building primarily customized Naval and merchant ships that make up seventy-five percent of its total production, and Japan building ships of standard design that more readily adapt to automated procedures, a realistic comparison, between the two countries in anything other than the number of employees, is meaningless and has not been attempted. However, the cost of this labor becomes quite meaningful when the number of employees is combined with the wage rate data in Figure 4.⁽¹⁷⁾

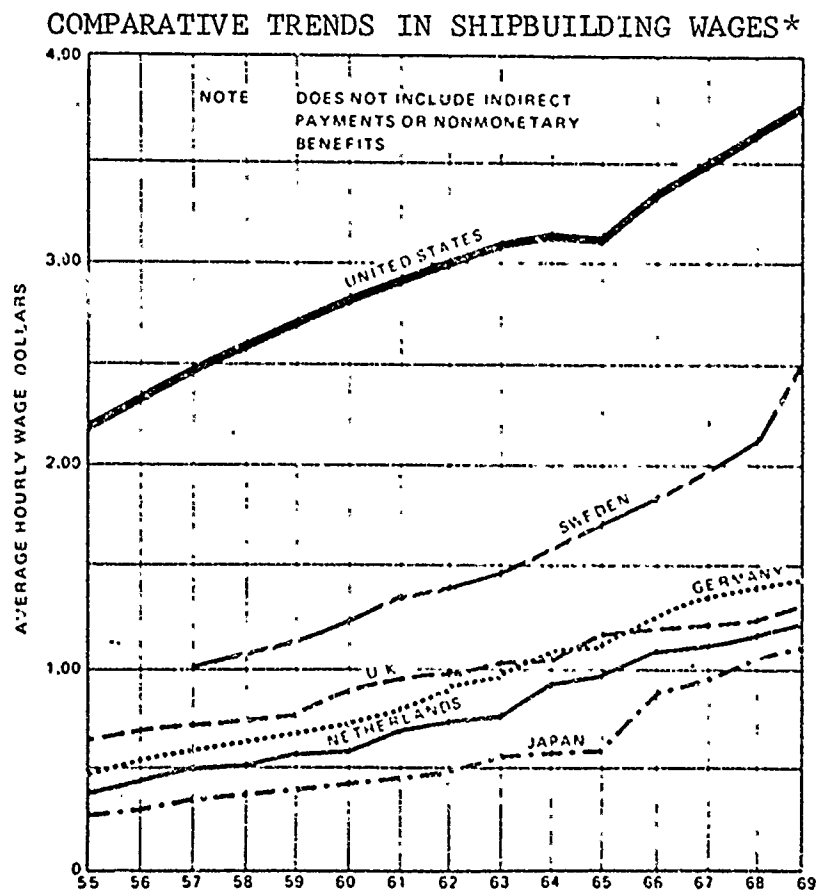


Figure 4.

The average hourly wage rate in the United States in 1970 was \$3.75 as compared with \$1.25 for Japan. Although the wage rate has been increasing in the United States at a rate of about four percent to about 20% in Japan,⁽¹⁸⁾ the current differences are still substantial.

When this wage rate ratio of 3 to 1 (\$3.75 to \$1.25) is applied to the \$12,000,000 cargo ship costs stated earlier, it can be seen that this could account for a twenty-five percent lower production cost. If the cost of material and externally manufactured items is seventy percent of the United States cost,⁽¹⁹⁾ and this is applied to the \$12,000,000 cargo ship costs, the Japanese production costs would be reduced by another 17%, giving a total reduction of forty-two percent.

The Maritime Administration has estimated that the costs of building ships abroad are forty-five to sixty percent less than the United States costs. This has been reflected in the construction-differential subsidy rate of about fifty percent that has been granted shipbuilders.⁽²⁰⁾ It follows, therefore, that there must be something other than labor and material savings that make up this difference between the forty-two percent and the estimates of the Maritime Administration.

Before continuing, it should be pointed out that labor costs per ship are not only a function of the wage level, but are also a function of the quality and layout

of the shipyard equipment and the labor learning that is associated with the construction of a single ship as compared to a series of several ships of the same design.

Since it is difficult to compare productivity of a foreign shipbuilding nation such as Japan with the United States and have the results be meaningful, a comparison was made within the United States to determine if any correlation could be made between U. S. industries. As a measure of productivity, the standard used was the value added per man hour of production worker. The industry chosen was transportation, since shipbuilding broadly fits into this category. For comparison, aircraft, railroad and street cars, and trailer coaches were chosen as the ones that most nearly fit the criteria of shipbuilding; all tend to require the same type of labor skills, to be assembly line type industries, and have the ability to customize the product.

The aircraft industry offers the closest to what would be the optimum method of production for shipbuilding, building a number of high cost units of a standard design, except for minor modifications in items such as interior trim, etc. Table IV displays the results from the Department of Commerce, Industrial Census of Manufacturing, 1967,

by the same four industries used in Table IV.

TABLE V.

New Capital Expenditures*

<u>Year</u>	<u>Shipbuilding and Repair</u>	<u>Aircraft</u>	<u>Trailer Coaches.</u>	<u>Railroad and Street Cars</u>
1958	38.7	94.2	7.7	8.6
1959	33.8	89.7	8.0	9.3
1960	28.9	62.8	3.8	8.5
1961	31.6	71.8	3.7	11.9
1962	23.0	119.7	2.8	10.9
1963	24.5	114.6	9.6	25.2
1964	32.8	102.9	9.6	25.2
1965	44.6	140.5	12.6	25.7
1966	52.8	378.4	9.8	35.1
1967	70.3	408.2	14.6	29.6
1968**	75.9	na	na	na
1969**	88.2	na	na	na

From Table V. it can be seen that the shipbuilding industry has made significant investments within the past five years which could account for the rise in productivity. For comparison, the aircraft industry in 1962 made a large capital investment, and productivity, from Table IV, increased markedly the following year when the impact of the new investment would have been realized; the same thing happened between 1966 and 1967. It is realized that since these figures represent new investments and not the net investments of the industry, definite conclusions cannot be made; but it is believed that a relationship can be seen. Figure 5 gives a pictorial representation of the shipbuilder's new capital investments.

* 1967 Census of Manufacturers, Vol.11, Industrial Statistics, Part III, p. 37C-8, Jan. 1971, U.S. Department of Commerce

** 1968-69 Data from Statistical Quarterly of Shipbuilder's Council of America, Third Quarter, 1971.

NEW CAPITAL EXPENDITURES IN U.S. SHIPBUILDING INDUSTRY

CAPITAL EXPENDITURES IN U. S. SHIPBUILDING INDUSTRY

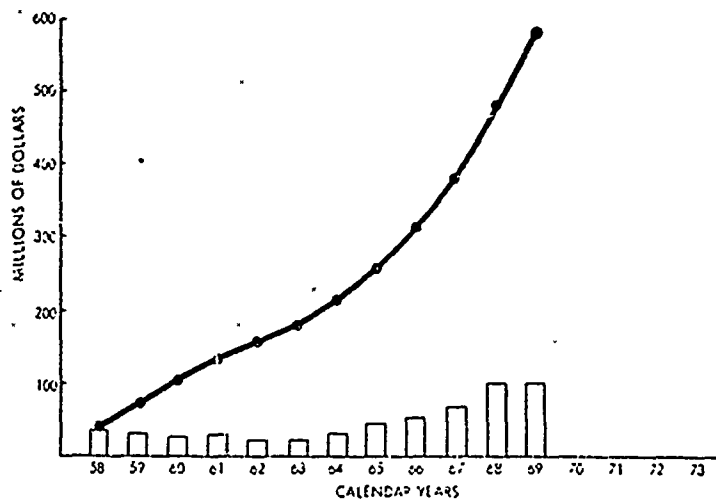


Figure 5.

3. Capital Investment in the Shipbuilding Industry

As stated in an earlier section, shipbuilding, by the very nature of the work involved in the construction of ships, is highly labor intensive, and the construction of naval ships because of their complexity is even more labor intensive than non-naval ships. The costs associated with this labor are significant contributors to the high costs of building ships. As stated by RADM Nathan Sonenshein, "the high cost of building ships in the United States stems primarily from U. S. labor cost."⁽²³⁾ This problem is not unique to the United States as Figure 5 shows; the labor costs throughout the world are increasing at a rapid rate. In Japan, for example, the increased labor costs have been translated directly into shipbuilding costs. In 1966, a tanker capable of carrying 100,000 tons of crude oil could

be built for \$65 to \$75 a ton; in 1971, the cost was about \$100 a ton.⁽²⁴⁾ In 1970, in the USSR, a production objective that had top management attention was to reduce the labor intensity in the shipbuilding industry.⁽²⁵⁾

High costs are not the only problem a labor intensive industry faces; there is the requirement for a large work force, which for shipbuilding requires many highly skilled craftsmen. Many of these same craftsmen have the skills that are in demand in other industries. In the United States, one of the greatest competitors for the work force comes from the construction industry which historically has paid higher wages. For example, the average hourly wage of a contract construction worker in November 1971 was \$5.89 while that of the shipbuilding worker was \$4.18. During the average week, the construction worker worked 38 hours and was paid \$223.82; the shipbuilding worker worked 40 hours and was paid \$167.20.⁽²⁶⁾

The same is true in Japan where, in spite of efforts of the Japanese shipbuilding industry to hire more employees to keep up with the increasing demand for their ships, their work force has remained relatively constant. The answer to this problem would seem to be to make shipbuilding less labor intensive and more capital intensive; thus cutting the high labor costs associated with shipbuilding and lessening the requirement for an ever-increasing work force. Capital will never completely replace the large amounts of labor that are required to build a ship, but capital can be used

as a substitute in many operations. This has been done by many of the foreign and a few of the United States shipyards, such as Litton, by converting their operation from a construction to a production type.

In a construction type shipyard, the worker operates much as a carpenter building a house. He moves about the ship and the yard making measurements, ordering and gathering materials, cutting them to fit, and fastening them in place. Not until the ship's hull is all welded together do pipe fitters, electricians, and sheet-metal workers take over. Their work in the completed hull somewhat resembles the costly process of rewiring an old house, and often no two ships emerge exactly alike. A production type shipyard attempts to emulate the automobile assembly line process, in which all components are precut and prebent. Materials are brought to the worker automatically and wiring, piping, and sheet-metal work are installed during a stage in ship's construction when their sites are most accessible. Most of the world's production shipyards also have adopted the technique of building hulls in several sub-assemblies, each complete with wiring and piping. Huge cranes are used to fit these sections together for welding into complete ships.

The production of something as large and complex as a ship by the assembly line process, requires a great deal of planning and scheduling plus a large investment in materials and handling equipment. This trend toward a capital intensive

approach also requires "series" production, i.e., building a large number of ships of virtually the same design in one place, a procedure that was used during the World War II mobilization when the shipbuilding effort was so effective.

This has not been the practice in the United States until recently. When the Navy had a large number of ships to buy, it scattered them among several private or naval shipyards. The picture in the commercial shipbuilding area has not been much different; orders were small and shipbuilders tended to custom-build the ships. Contrast this with the procedure in Japan, for instance, where the shipyard has a few standard designs and the customer chooses the design that most nearly fits his need. Because the U. S. shipyards' orders have tended to be small, and subject to fluctuations, most have tried to minimize fixed costs by staying labor intensive and by laying off people when work was cut back. This can be seen from the dramatic regional employment data in Table II.

Compared to other industries such as aircraft, the amount spent on capital investment has been small. For example, in 1964 all U. S. manufacturing industries spent \$20 on new capital investment for every \$100 in wages, the aircraft industry spent \$15 and shipbuilding spent \$5; in 1967, the aircraft industry spent \$25 and shipbuilding spent \$9;⁽²⁷⁾ in 1969, shipbuilding spent \$10.⁽²⁸⁾ Thus, there is a trend within the industry to invest in capital intensive

equipment to make the shipworker more productive and to cut the overall labor costs, but compared to most other sectors of the economy, the increase is slow.

The problem has been well defined by RADM Nathan Sonenshein in his testimony before the Status of Shipyards Hearings in 1970 when he stated, "Much of the U. S. shipbuilding capacity is obsolescent, not only by standards of production efficiency, but also in terms of age and ability to handle the large ships of the future. There is a revolution taking place in the size of commercial ships sailing the oceans, and most U. S. shipyards are not physically adequate to handle the larger vessels. Because of wage costs, manning levels, economies of size, and improvements in systems technology, the trend toward larger, faster ships is expected to accelerate."⁽²⁹⁾

Where does the United States' private sector shipbuilding stand in regard to these new ships? How prepared are the present, private and naval shipyards for the future? To build commercial ships such as the modern 200,000 ton dead weight tanker, requires a building position that is capable of holding the 1000 foot ship; in the United States there is only one building position available for commercial shipbuilding to construct a ship of that size.⁽³⁰⁾ There are facilities available capable of handling ships in the 700 foot category in a number of shipyards. A discussion of the capacity and capabilities of the naval shipyards is given later in this chapter. The Honorable Andrew E. Gibson,

Maritime Administrator, in his concluding remarks to the Seapower Subcommittee, stated, "It appears that the shipbuilding industry has the capability to meet the requirements of the Navy and merchant ship programs during the next few years. On the other hand, to meet merchant ship construction cost goals, I believe that new and more efficient facilities will be required. I can only conclude that only those shipyards which do carry out extensive modernization programs will be in business several years from now."⁽³¹⁾

Industry for the most part agrees with the fact that modernization is required if the United States shipbuilders are going to be competitive. As Mr. Ellis B. Gardner, Jr., President of Ingalls Shipbuilding Corporation, has stated, "If our industry, company by company, would specialize and, in so doing, each gear itself for the production of specialized ships, as have the Japanese, and if the wage differential between ourselves and our counterparts abroad continues to narrow, then we see no reasons why American shipbuilding enterprise cannot compete aggressively and effectively against the Japanese and Europeans within the coming decade, particularly for the more complex ships for which we have a better design capability," He qualifies this further, "The basic volume of ships to be produced must be designed by the manufacturer who will produce them in order to achieve the economies of production design integration and in order to achieve the standardization in

the manufacturing operation which is so vital to its efficient success."⁽³²⁾

Mr. L. C. Ackerman, President of Newport News Shipbuilding and Dry Dock Company, stated that certain actions are necessary if the United States is to maintain a strong shipbuilding capability:

(a) "Congress must provide the long-term commitment to a continuing program of naval and merchant ship new construction. This commitment is absolutely necessary to justify the expenditure of capital required to modernize and keep modern our shipyards. Only modern shipyards will allow American shipbuilders to build modern, competitively priced ships.

(b) Individual shipyards must have the incentive to develop specialized facilities to build long series of standardized ships."⁽³³⁾

The Japanese, then, have become the mentor for the United States shipbuilding industry. It is interesting that they developed their present shipbuilding system and technology based on that of the United States that proved so effective in World War II. They are continuing their progress and attempting to become less labor intensive because of the shortages in their labor market. As an example, they have recently announced in the "Marine Engineering/Log, April 1972", that a shipbuilding company has developed the first large-size and high-precision pattern processing system that designs the layout of equipment, piping and wiring for ships, making possible a significant saving of man-hours. To compare with the United States limited facilities for the new large ships, over 200,000 dwt and over 1000 feet, a new

shipyard in Japan has been completed which has a building dock 2657 feet long and 307 feet wide; all ship construction work, including the outfitting, will be conducted in the dock. With this, the shipyard will be able to produce five ships of the 250,000 dwt class⁽³⁴⁾ per year.

The USSR has realized that there are changes occurring in the world shipbuilding industry and has made the following the prime objectives for its industry:⁽³⁵⁾

- (a) Series production of standard ships
- (b) Reduced labor intensity
- (c) Design ship for producibility
- (d) Standardization of components
- (e) Overcome demand for custom ships
- (f) Cost-benefit analysis of facility improvements
- (g) Total yard integration of mechanization and automation

The United States shipbuilding industry is well aware of its problem and has been increasing its capacity. It is evident that progress must continue if the United States is to ever become a competitor in worldwide shipbuilding in a field, other than the special customized ships.

B. PROFIT TRENDS IN THE SHIPBUILDING INDUSTRY

Shipbuilders dealing in the market for warships have undergone a corporate transformation in the last decade. In the early 1950's, the industry was comprised of a large number

of independent firms whose primary business was shipbuilding, whereas only a few firms exist today. Now, the typical shipbuilder in the armaments market is a division of a large conglomerate corporation. General Dynamics grew from the Electric Boat Company, and Bath Industries owes its parentage to the Bath Iron Works. Litton Industries, Tenneco, Ogden, and Kaiser Corporation acquired their shipyards at bargain rates during the 1960's. One result of the "conglomeration" of the shipbuilding firms is that it is nearly impossible to uncover statistical profit data on the operations of the shipbuilders. There is, however, a considerable body of research on the Defense Industry in its entirety which displays and analyzes profitability. This work was done under contract by the Logistics Management Institute.⁽³⁶⁾ The results it has published to data analyze profits reported by major defense firms from 1958 to 1966.

In the absence of valid profit data which displayed the profit experience of the shipbuilders engaged in government business, it was decided to consider the LMI information which was based on all major defense contractors. There are two reasons why this should be done: first, the shipbuilders were subject to the same profit regulations and policies as the LMI sample; second, the trends which the LMI data revealed are significantly similar to those which the shipbuilding industry has testified as prevailing in their industry.⁽³⁷⁾

The LMI studies were aimed at determining the profit on Total Capital Investment (TCI)(which they defined as equity capital investment plus long-term debt) from the portion of the total industry which could be allocated to defense business. This they compared with the profit being generated on the portion of TCI, which was allocated to the commercial business of these same defense contractors. Finally, they compared the data to the profits of a sample of some two hundred manufacturers of durable goods, which was compiled from Federal Trade Commission data (FTC-SEC).

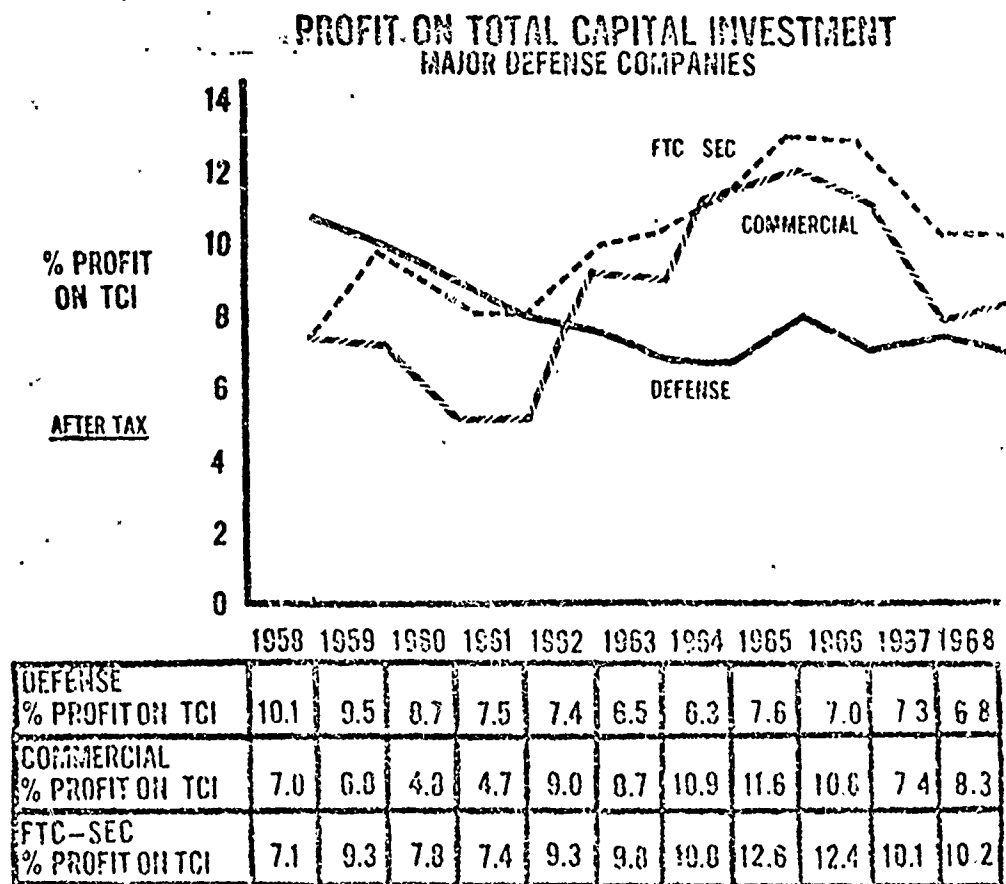


Figure 6.

As the LMI stated in its study: (38)

"Average defense business profit as a percent of total capital investment trended steadily downward during the first seven years of the study period. It has increased and decreased by small margins in alternate years since 1964, remaining slightly above the 1964 level.

The averages of commercial and FTC-SEC profits on total capital investment were higher than defense business profits average in 1968, as was the case for the preceding six years. The gap widened in 1968."

To insure that the mean did not distort the implications of the data, the LMI also compared the range of Defense profit which enclosed 68% of the contractors and again contrasted the results with the durable goods industry. The comparison showed that: (39)

"High profit defense business has been less profitable than high profit commercial business. Low profit defense business was more profitable than low profit commercial business during the period 1958 through 1961, but has been less profitable than low profit commercial business during the seven years 1962 through 1968."

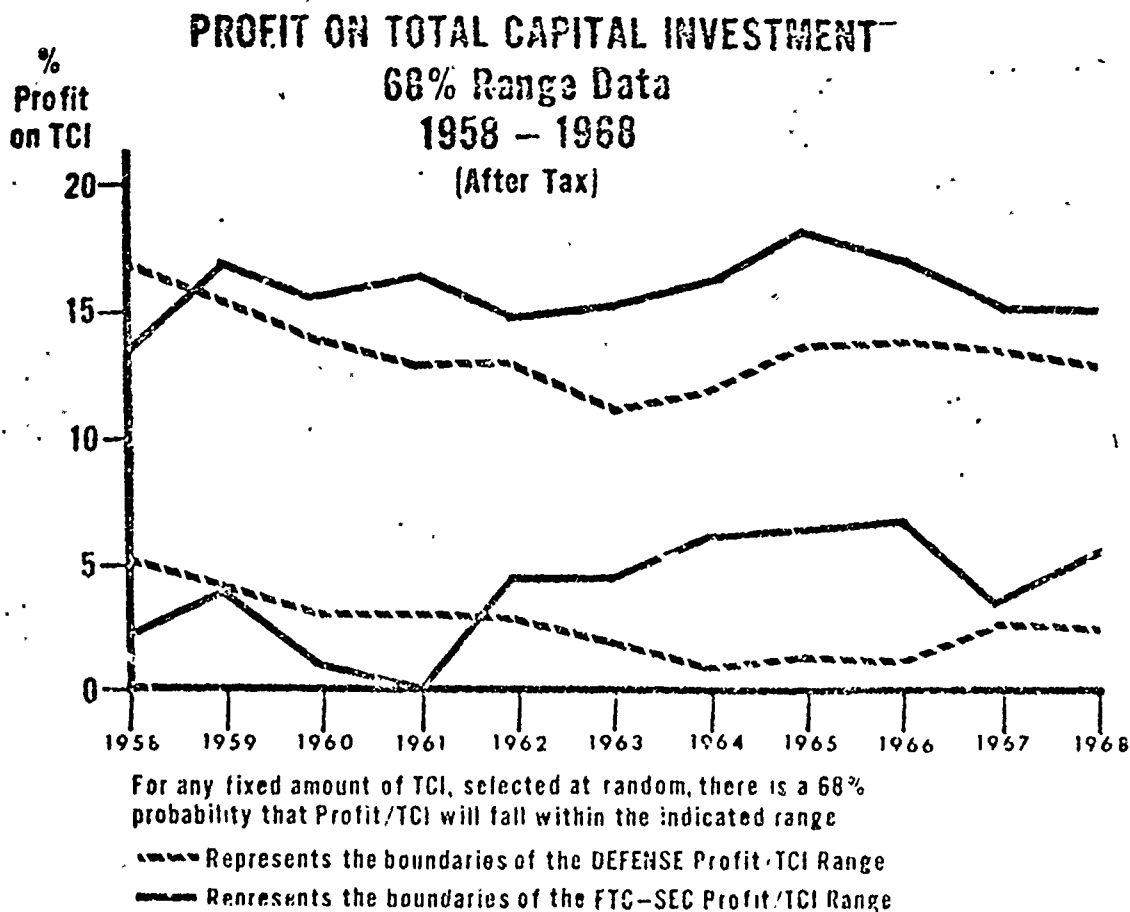


Figure 7.

To insure that the survey technique which it employed did not result in distortion of the sample, LMI also compared the audited financial statements of the defense sample with the FTC-SEC data. The results, shown in Figure 7, proved to be consistent with the conclusions previously reached.

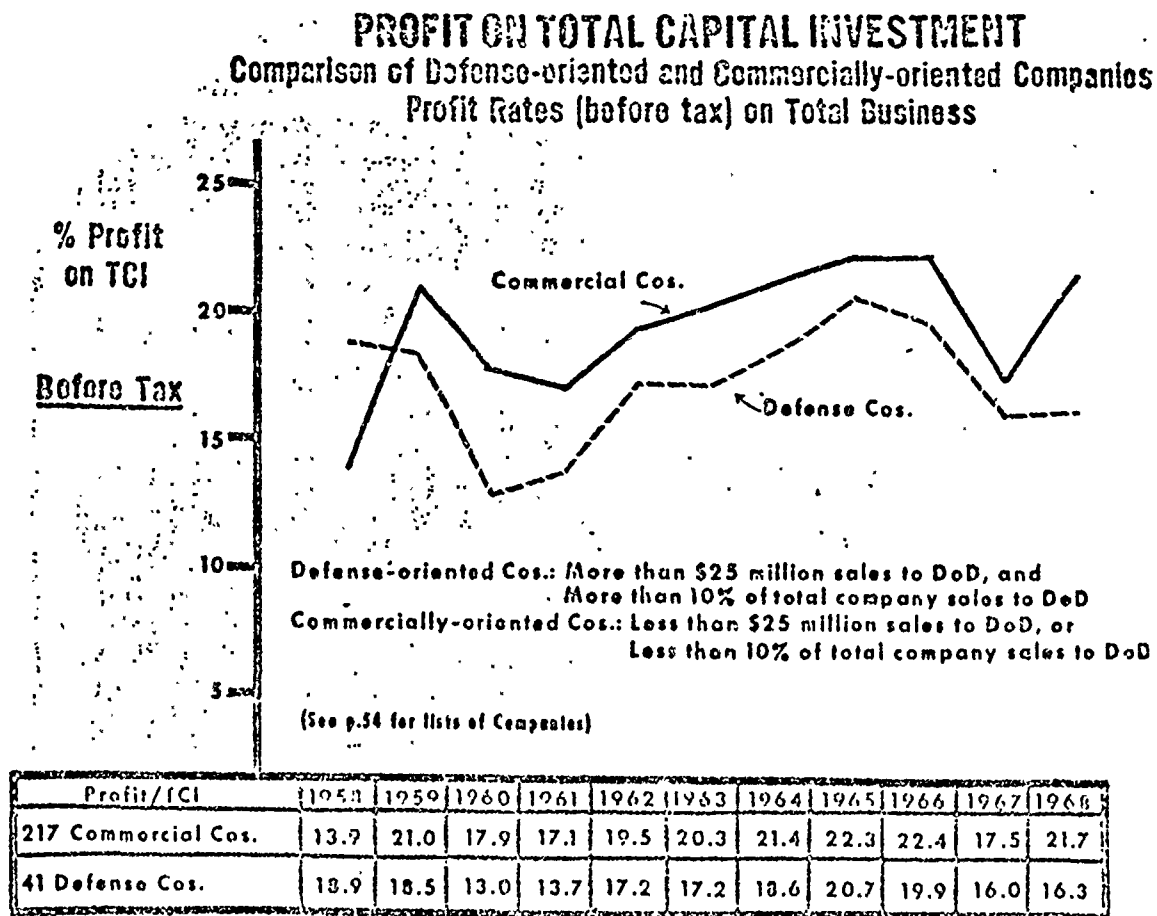


Figure 8.

As was stressed earlier, the profit objectives for negotiated defense contracts are developed as a percentage of the anticipated costs. It has been a policy of the Department of Defense, since the early McNamara days, to reward these firms taking higher risks with higher profits, and the negotiated profits have reflected this standard. It is important to note that the experiences of the contractors, in terms of the profits actually achieved in the 1960's, did

not conform with this goal as the Table below indicates.

<u>Contract Type</u>	<u>Profit / Sales</u>	
	<u>1968</u>	<u>1967</u>
CPFF	4.2	5.0
CPIF	5.0	5.7
FPI	4.1	3.9
FFP	3.3	3.7

The average profit on sales of these contracts which involved active price competition (which are included in the FFP and FPI data in the Figure for 1968 was 2.0% and for 1967 was a lowly 0.9%.⁽⁴⁰⁾ These values are sharply lower than the ex-ante fees and profits negotiated.

When Secretary McNamara took charge of the Department of Defense in the early 1960's, he took two actions simultaneously. First, he announced that the profits in the defense industry were too low, and, second, he proclaimed the policy of shifting the risk to the contractors.

If the improvement of profit was the policy, why, then, did the trend turn in a lower direction? There are a number of possible explanations, but the theory advanced by Scherer has the greatest relevance to shipbuilding. He maintained⁽⁴¹⁾ that because excess capacity was abundant in the defense industries, the opportunity cost for the (idle) facilities was probably zero. Therefore, the contractors bid into contracts with overly optimistic bids and took what meager

profits were left after the overruns. Thus, the over-capacity in the market, not the government's profit policy, established the profit margins and led indirectly into the overruns. The market forces can establish themselves above the regulations even in this highly restricted market.

Profit is generally agreed to be a reward for the risks to which the firm exposes its assets. The higher the risk, the higher should be the profit demanded. With the arrival of the concept of large multi-year procurements in shipbuilding, comes the promise of very large potential profits, very intensified competition, and the opportunity for very large losses if the goals are not met. The policy of larger but fewer buys greatly increases the risks of participating in the shipbuilding industry. Whether the increase in profits will be commensurate with the increased risk remains to be seen.

C. THE ROLE OF A PROFIT POLICY

The total system cost of a modern weapon system has undergone such inflationary growth in recent years that serious questions are being posed as to the ability of any nation to develop and produce the high-technology weapons which purportedly are necessary for the national defense. Warship construction costs have risen to the point where a single aircraft carrier is priced at more than a billion dollars; a modern destroyer is estimated at nearly \$100 million. A destroyer escort during World War II was built

for an average cost under four million dollars; a ship designed to perform the same mission against today's opposition costs more than ten times that amount. Mr. David Packard, in his remarks upon his departure from the office of the Deputy Secretary of Defense, directed the attention of the nation to this impending cost crisis in defense systems procurement. Cost overruns and the intensive criticism that they have received from Capitol Hill, have heightened the already acute awareness with which military managers and contracting personnel have regarded the area of system cost.

Crises engender a state of mental myopia whenever they occur, in the defense business as elsewhere. If an overwhelming emphasis is placed upon the reduction of cost, then, in the inevitable reaction, other factors will receive less than their proper weight. All too frequently crisis management will sacrifice substantial long-term benefits for relatively minor short-term gains. It is the purpose of this section to emphasize the role of contractor profit in the shipbuilding industry and to discuss the relationship to the prices that the Navy and the nation pays for its ships both in the short run and over time.

In the negotiations preceding the award of the shipbuilder's contract, the government's negotiator is faced with the problem of bringing back to his superiors a contract for the vessels under consideration within the constraints

of the budget he has been granted. If the contractor's proposal is higher than the budget allows, the negotiation process from the government's viewpoint has the objective of whittling whatever excess exists from the contractor's cost and profit figures while sacrificing as little as possible in the performance of the product to be delivered. The contractor's cost figures can be questioned, but there is a limit beyond which they cannot be reduced without some parallel reduction in the ship's characteristics. Profit is not subject to any similar constraint, although in practice it varies within a very narrow band. The Armed Services Procurement Regulations provide an abundance of subjective criteria in the weighted guidelines which the contracting officer is charged to interpret. If faced with the choice of the profit target by one half percent or sacrificing that extra margin of, say, reliability, the loyalties of the negotiator to his employer would probably influence his choice. Shipbuilders would, of course, refuse to accept contracts which promise less than adequate profit if their facilities could be occupied with more profitable business. American shipbuilders, however, are only now emerging from two decades of chronic overcapacity, a legacy of our World War II mobilization programs. Despite the exodus of many shipbuilding firms from the industry,*

* Among the builders of ships listed as active in the U.S. Navy in Jane's Fighting Ships 1970-71, the following firms have left the industry: Federal Shipbuilding and Dry Dock Co., Consolidated Steel Corp., Seattle-Tacoma Shipbuilding Corp., Gulf Shipbuilding Corp., Brown Shipbuilding Co., Cramp Shipbuilding and Dry Dock Co., Manitowac Shipbuilding Co., and N.Y. Shipbuilding Corp. Numerous others have been merged into larger firms.

demand for their facilities is still running about sixty percent of capacity.**

The market structure in the American shipbuilding industry further weakens the bargaining position of the contractors. Unlike their counterparts in the Aerospace industries, shipbuilders have had little commercial business in ship construction in the past two decades. As shown in Table VI, Navy new construction contracts have comprised approximately 75% of all ship construction in the 1960's. Military work tends to be a much higher share of the business of those yards which have retained the capability of warship construction. Faced with a monopsonistic market structure, the shipbuilder has the choice of (1) accepting substandard profit rates (as long as they cover his variable costs) against the hope of long-term improvement in the market, or, (2) abandoning the market. Paradoxically, the firm that has built more Navy ships than any other, the Bethlehem Steel Corporation, has adopted a policy of not seeking any more Navy work so as to concentrate on more profitable privately financed contracts. (42)

** In testimony before the Seapower Subcommittee of the House Armed Services Committee on 29 June 1970, Edwin Hood, President of the Shipbuilder's Council of America, testified: "We estimate that present facilities are employing a work force in the range of 55/60 percent of optimum numbers and the facilities are being utilized at approximately 60/65 percent of total available capacities."

TABLE VI.

VALUE OF WORK DONE BY PRIVATE FIRMS
IN THE CONSTRUCTION OF NEW
SELF-PROPELLED SHIPS
(in millions of dollars)

<u>Calendar Year</u>	<u>Total</u>	<u>Military Ships</u>	<u>Non-Military Ships</u>	<u>Military as % of Total</u>
1963	\$ 925	\$ 682	\$ 243	74%
1964	1019	739	280	73%
1965	1018	741	277	73%
1967	1337	975	362	74%

Source: Census of Manufacturers, 1967
Table 6A.1, p. 37C-21

Contractor profit is one of the factors that comprise total system acquisition cost. A simple extension of this logic would lead one to the conclusion that merely by reducing profit it is possible to lower the system's price. However, as the cost-incentive contracting experience has shown, it is also possible to use profit augmentation to reduce the overall cost.⁽⁴³⁾ The concept is simple; incentives are structured into a contract for increased profits for cost reductions effected by the contractor, so that the government receives a system at the lowest price while paying the builder a substantially higher profit. This incentive works on the premise that the contractor is attempting to maximize his profits from a given contract; that is, he is maximizing short term profits. More subtle but more germane to this discussion is the effect which

government profit policy has on the long range objectives of shipbuilding firms.

The long range decisions of the firm, those regarding its level of investment in capital equipment, its plans for expansion or contraction, and its strategy with regard -- the markets in which it expects to compete are determined by the firm's expectation of future profits. It is against these expectations that it is possible to apply a second level of incentivitation which Scherer refers to as "competitive incentives." These forces are commercial stimuli which exploit the "desire of firms to survive, to grow and perhaps to maximize long run profits."* In this arena, the firm tries to assure, as a minimum, return on its investment sufficient to cover its risk-free cost of capital.

Additionally, the rational investor looks for some compensatory remuneration for the risks to which he is exposing his capital. If denied a reasonable assurance that the discounted future cash flows expected from a project at least equal the outlays required, the shipbuilder will forego the project. If, for example, the project in question was the purchase of some cost-reducing capital equipment, the implication for the government of the contractor's decision is that it will have to face the same (high) level

* Scherer's Discussion of the Operation of Incentives on the Weapons Systems Contractor in Chapter 1 of his The Weapons Acquisition Process - Economic Incentives, Harvard, Boston 1964 is recommended reading for those with an interest in this area.

of costs in future dealings with this contractor.

Only the assurance of a stream of payments will draw investment capital into the shipbuilding industry; only new investment capital can replace the aged and inefficient capital stock that characterizes much of the industry. Mr. L. C. Ackerman, President, Newport News Shipbuilding and Dry Dock Co., and Vice-President, Tenneco Inc., expressed very clearly the decision process of most sophisticated investors:

"It is absolutely necessary that we clearly see a reasonable opportunity for a competitive profit before we make the extremely large investment required to move shipbuilding from a labor intensive to a capital intensive industry. The fact that this has not existed for the past 25 years is chiefly responsible for shipbuilding remaining so labor intensive... If there is not reasonable assurance of an adequate market, large investments in equipment are foolish."⁽⁴⁴⁾

The extremely low probability of long range profit which most investors assigned to the shipbuilding industry largely precluded the introduction of new equity capital throughout the 1950's. Debt financing for long term investments was also unavailable owing to low capitalization and the poor earnings performance of most of the yards.⁽⁴⁵⁾ Where, then, could the firms obtain the funds required to replace their inefficient capital stock? The funds generated by operations barely covered the costs of the typical shipbuilder. Little depreciation was available from the aged capital equipment. Thus, it appeared that the shipbuilding industry was ensnared

in a vicious circle of cause and effect: low profits which result from low demand and unused capacity which, in turn, resulted from non-competitive prices which was caused by an inefficient capital stock which cannot be replaced because of the low profit in the industry.

Only the considerable promise of greatly increased shipbuilding programs sponsored both by the Navy and by the Maritime Administration was able to attract the flow of new investment funds, largely from conglomerates such as Tenneco and Litton Industries. Although other considerations* may have affected Tenneco's decision to purchase its shipyard, Mr. Ackerman leaves no doubt as to the basis of further investment decisions:

"where the projected improvements require the investment of capital, the projects are ranked in order of anticipated return on investment and the more attractive from this standpoint are given first consideration."(46)

Within the conglomerates, the shipyard must compete with their sister divisions for investment dollars. Even the depreciation which the shipyard generates may be reinvested in office machinery or in luxury motels if, in the marginal benefit measured by the discounted flow of funds, the shipyard fails to come out on top.

* It is difficult to assess the relative importance which the conglomerate places upon the tax loss carryforward and potential write-off from downward adjustment of asset valuations, which are positive advantages only because of the peculiarities of our tax laws, in making these acquisition decisions.

In 1963, the Secretary of Defense, after an extensive review of the profit and investment trends in defense industries issued the following profit guidance in the ASPR:

"(a) General. It is the policy of the Department of Defense to utilize profit to stimulate efficient contract performance. Profit generally is the basic motive of business enterprise. The Government and defense contractors should be concerned with harnessing this motive to work for more effective and economical contract performance. Negotiation of very low profits, the use of historical averages, or the automatic application of a predetermined percentage to the total estimated cost of a product, does not provide the motivation to accomplish such performance. Furthermore, low average profit rates on defense contracts overall are detrimental to the public interest. Effective national defense in a free enterprise economy requires that the best industrial capabilities be attracted to defense contracts. These capabilities will be driven away from the defense market if defense contracts are characterized by low profit opportunities. Consequently, negotiations aimed merely at reducing prices by reducing profits, with no realization of the function of profit cannot be condoned. For each contract in which profit is negotiated as a separate element of the contract price, the aim of negotiation should be to employ the profit motive so as to impel effective contract performance by which overall costs are economically controlled. To this end, the profit objective must be fitted to the circumstances of the particular procurement, giving due weight to each of the performance, risk, and other factors set forth in this 3-808. This will result in a wider range of profits which, in many cases, will be significantly higher than previous norms."(47)

If this country is to maintain a viable shipbuilding mobilization base within the private sector, it is clear that the opportunity for a competitive profit must be made available. If the industry is to receive the investment capital it requires, the level of profits must be made equivalent to that available to firms bearing comparable risk

in the private sector. The technology is available to effect great reductions in shipbuilding cost. The demand for new ships in the next decade is causing some industry sources to refer to the 1970's as the "Maritime Decade". There exists a clear opportunity to rebuild and restructure the shipbuilding base, and the influx of private capital from the large conglomerates has enabled some yards to start extensive modernizations.

There is a general recognition within the Department of Defense that there is a need to revise the existing profit policy to encourage the construction of efficient facilities. At the same time, it is vital to insure that the private investment in productive facilities, which has been expanding in recent years, is not over-incentivized so as to lead to shipbuilding capacity which far exceeds our long term requirements. Some excess capacity is the price paid for a mobilization capability, but too great an excess leads to unattainable breakeven points. An examination of the incentives provided by the existing profit policy is the first step in developing a program to strike the delicate balance between long run equilibrium and another cycle of boom and bust.

1. Economic Structure of American Market of Warships

There is only one consumer in the market for warships in the United States, and, of course, industry sources maintain that the Navy exercises monopsonistic powers over the

shipbuilding industry. It is certainly true, that if it chose to do so, the Navy could exercise strenuous control over this market in which it supplies between 65 and 75% of the business. Even these figures understate the control which the Navy could exercise over such traditional warship manufacturers as Bath and Electric Boat, where virtually all the work performed in the last decade has been under Navy contract. This concentration of consumer strength is much more pronounced in shipbuilding than in aerospace where there has been strong civilian demand. The individual services have also competed for resources in aerospace, as has NASA and a large number of allied air forces. Despite its leverage, the Navy is no doubt restrained from exercising fuller control over the industry by the political onus of such action, quite possibly, by its genuine desire to see the industry grow strong and viable. Since the Navy can, to a large extent, predetermine the ceiling level on profits, its actions can draw investment to shipbuilding or drive firms from the industry. (See Chapter III)

The exodus of many of the weaker firms has resulted in some concentration of economic power in the industry. However, the high degree of specialization which is required to produce the different types of modern warships has resulted in a simultaneous fragmentation of the warship construction industry into several distinct markets. Consequently, as Table VII illustrates, these markets vary over the range from monopolistic to competitive.

TABLE VII.

APPROXIMATE COMPETITIVE STATUS IN
FIVE WARSHIP CATEGORIES

	<u>AIRCRAFT CARRIERS</u>	<u>NUCLEAR FRIGATES</u>	<u>SUBMARINE & USMS</u>	<u>DESTROYERS & DLG</u>	<u>LARGE AUXILIARIES</u>
# of Com- peting firms	1	1 (2 other potential)	3	8	12 (or more)
Parent Firms	Tenneco	Tenneco (General Dynamics) (Litton)	Tenneco General Dynamics Litton	Tenneco General Dynamics Litton Ogden Bath Todd Defoe Lockheed	Tenneco General Dynamics Litton Ogden Bath Todd Defoe Lockheed Alabama Ship & DE Kaiser (NASSCO) Bethlehem Sun Oil

As Table VII indicates, the competitive status of these industry fragments fall into one of three categories: Monopoly, oligopoly, and open competition. Some brief expository comments on these categories might be helpful:

a. Monopoly

Aircraft Carriers - This market is nearly a pure case of bilateral monopoly, with one manufacturer, Tenneco's Newport News Facility, and a single buyer, the U. S. Navy. The only relaxation of the bilateral monopoly model results from the ease with which Newport News can shift her productive facilities to other markets (i.e., merchant shipping,

frigates, etc.). This painless exit from the market is constrained to some real but immeasurable degree by the ex-market pressures which the customer can bring to bear. Tenneco cannot fail to realize that it occupies a sensitive position as the sole producer of a vital defense system and that awareness must certainly limit its options.

Nuclear Frigates - Newport News also has a virtual monopoly in the production of Nuclear Powered Frigates. The General Dynamics yard at Quincy, Massachusetts, built two nuclear powered combatants in the early nineteen sixties (while that yard was owned by Bethlehem Steel) and it still claims that construction capability. One other builder, Litton's Ingalls Division has the potential capability to compete for these contracts but it has not yet done so.

b. Oligopoly

Submarines - In the construction of submarines, the producer's market approaches the duopoly case. Two firms, Tenneco and General Dynamics (Electric Boat Division) compete in this market, but the competition is rarely decided on the basis of price alone. Often, it appears that contracts are awarded on the ground of maintenance of competition. One other firm, Litton's Ingalls Division, has a submarine construction capability but its business efforts recently seem directed toward overhaul, repair and conversions of both submarines and frigates. Ingalls did not receive any portion of the most recently let submarine construction contract in which thirteen vessels were awarded to the two dominant firms. (48)

c. Open Competition

Conventional Frigates and Destroyers - There is an extensive list of competitors for destroyer type ship contracts although the demand for series construction in recent contracts has restricted access to these yards which can make the necessary improvements to accommodate this approach.

Large Auxiliaries and Amphibious Ships - The competitive situation for construction of these ships is virtually identical to that for destroyers. These ships are the most similar to merchant vessels and consequently require the least amount of specialized technology. In the event of a crisis, the number of capable facilities could be quickly expanded. Entry into this market is relatively easy.

The single point to be emphasized in this discussion is that the economic structure of the various markets which comprise the warship building industry vary considerably. One firm is capable of competing in every market; several can compete in a few markets; many can only gain entry into one or two markets. This variety has great significance if the government intends to develop a profit scheme that provides profit according to some set formula. It is an axiom of economics that competition, in general, can approach maximum allocation efficiency.

Competition, then, to the extent that it exists in defense procurement, is considered desirable; however, as

Peck and Scherer asset, a full market system for weapon systems is unattainable:

It is not only that a market system does not now exist in the weapons acquisition process. We can state the proposition more strongly. A market system in its entirety can never exist for the acquisition of weapons. To economists schooled in the virtues of the market system as a solution to the problems of economic organization, this is a regrettable conclusion.⁽⁴⁴⁾

The often stated intent of the government regulations with regard to profit is to approximate the effects of the competitive market pressure where that pressure does not naturally exist. This is the object in the regulation of public utilities and public transportation. It is also the presumed goal in the regulation of the systems acquisition process. Unfortunately, the history of such regulation is marred by distortion which the regulations have themselves fostered.

In shipbuilding, where competition exists alongside monopolies, caution must be employed in the enactment of regulations to insure that competition is not eroded by unforeseen side effects of the regulations. What occurs in the market for submarines may have an effect in the market for destroyers since the factors of production are similar. Considerable study should be given to the faults which have emerged in previous profit systems if the errors of history are not to be repeated.

III. ALTERNATIVE PROFIT POLICY

A. THE CURRENT APPROACH: WEIGHTED GUIDELINES METHOD

1. Application

As an outgrowth of a series of studies conducted by the Logistics Management Institute (LMI), in the early 1960's, the Department of Defense instituted a profit policy based upon the establishment of a series of weighted guidelines. The philosophy behind this policy is that the target profit or fee should reflect the amount and type of effort which the contractor is expending. For example, if the prime contractor intends to employ a highly talented design team on the contract, the Weighted Guidelines policy holds that he would be entitled to a higher profit objective than the contractor who intends to subcontract all of the work. Previously the profit or fee objective was not related to the type of work being performed and it would have been possible for both of the contractors in this example to request the same percentage of the profit on costs as their reward.

The Weighted Guideline procedure directed that the costs in the contract be broken out by category and assigned a weighting factor which would represent the relative complexity of the task. Table VIII summarizes the various cost categories and the weighting range currently allowed.

(50)
TABLE VIII.

CONTRACTOR'S INPUT TO TOTAL PERFORMANCE

	Weight Ranges
Direct Materials	
Purchased Parts - - - - -	1 to 4
Subcontracted Items - - - - -	1 to 5
Other Materials - - - - -	1 to 4
Engineering Labor - - - - -	9 to 15
Engineering Overhead - - - - -	6 to 9
Manufacturing Labor - - - - -	5 to 9
Manufacturing Overhead - - - - -	4 to 7
General and Administrative Expenses - - - - -	6 to 8

There is a clear emphasis in the Weighted Guidelines upon the employment of labor in general, and engineering labor in particular. The text in ASPR which describes the usage of the table further explains that the upper range of value within that category is to be reserved for those projects needing "notable scientific talent or unusual or scarce engineering talent."

In a trade-off between two proposals of equal overall cost, the higher profit figure is assigned to the approach which utilizes the greater amount of engineering effort. This places a premium on high-technology proposals. In another comparison between two projects, one an engineering effort, and the other a manufacturing effort, the higher profit figure would be assigned to the former.

In addition to weighting the various cost categories, the ASPR also provides for subjective criteria which reflect the contracting officer's assessment of past performance, requirements for new government facilities, the risk burden of the contract, etc., The motive of the Government in providing these additional categories is, in most cases,

self evident.

TABLE IX. (51)

CONTRACTOR'S ASSUMPTION OF CONTRACT	
COST RISK - - - - -	0 to 7%
Type of Contract	
Reasonableness of Cost Estimate	
Difficulty of Contract Task	
RECORD OF CONTRACTOR'S PERFORMANCE - - - - -	
Small Business Participation	
Management	
Cost Efficiency	
Reliability of Cost Estimates	
Value Engineering Accomplishments	
Timely Deliveries	
Quality of Product	
Inventive and Developmental Contributions	
Labor Surplus Area Participation	
SELECTED FACTORS - - - - -	
Source of Resources	
Government or Contractor Source of	
Financial and Material Resources.	
Special Achievement	
Other	
SPECIAL PROFIT CONSIDERATION - See 3-808.6.	

The category for source of resources was included to compensate for what was a recognized weakness in the Weighted Guidelines when they were initially devised. The LMI study team had originally believed that a weighting factor should be assigned to the capital employed on a contract but concluded that the practical difficulties in allocating a firm's capital assets to a specific contract outweighed the possible benefits. Consequently, there is today no explicit recognition of a firm's capital investment in the Weighted Guidelines Method. The category, source of resources, was included to provide an implicit incentive for capital investment by attaching a profit penalty to contractor attempts to use government owned facilities and equipment. As applied by the ASPR, the source of resources

weighting is only invoked if the contractor is requesting new government facilities; government property already in the inventory is not taken into consideration. This category, as it is employed, is designed to influence the contractor's capital investment plans. It is questionable what effect, if any, this element has on the capital/labor trade-off decision of the shipbuilding contractor. The weight placed upon labor is not offset by the seldom invoked source of resource penalty.

Two points about the Weighted Guidelines bear special mention. First, the WGL approach is an ex-ante effort designed to provide a target profit percentage. The actual profit which the contractor receives may vary widely from the target figure depending upon the type of contract awarded and the contractor's ability to achieve whatever incentive provisions are provided. Secondly, the target profit of fee figure, which the guidelines generate, is expressed as a dollar amount but is based upon a percentage of the projected cost. If two cost proposals are submitted by a single firm employing the same cost element proportion, then the higher dollar profit figure will be attached to the higher cost estimate. The basic philosophy is to provide a consistent profit on sales. In theory, if not always in practice, profit is positively correlated with cost.

2. The Effect of Weighted Guidelines on Defense Industries

An examination of the essential characteristics of hypothetical contracts which would be assigned the extremes

of allowable profit under the WGL might provide some clues to the peculiar incentive which they provide. For example:

Hypothetical Profile on a Maximum WGL Profit Work Effort

- (a) Involves considerable engineering design talent of the highest caliber
- (b) Is a very high cost effort
- (c) May employ little or no company owned capital resources
- (d) If there is any production activity, it involves handcrafting of the product (very labor intensive)

Hypothetical Profile of a Minimum WGL Profit Work Effort

- (a) Involves a highly mechanized, labor-saving production activity
- (b) Involves little, if any, engineering talent
- (c) Is a very low cost operation

Several points emerge from an analysis of this comparison which warrant further examination. There is a clear implied incentive to become involved in an activity which employs highly trained scientific personnel. Consequently, the design effort which the profit approach encourages is the one employing the most advanced technology. It is at least a possibility that this implied incentive is partially responsible for the delivery of overly complex specifications with a reliance upon sophistication when simplicity would suffice.⁽⁵²⁾ This provision may increase the technological risk of the system under contract. It may also lead to a misallocation of an important national resource: the available pool of engineering talent. If the weight on engineering

labor is excessive, then engineering talent could be ineffectively allocated to defense contractors. Any hoarding of these technical talents could oppose the overall goals of the nation.

In the past, this would not have been a serious issue in the shipbuilding industry, as opposed to aerospace, owing to the Navy's tradition of designing ships "in house" (i.e., within the Bureau of Ships). Bids were requested to construct the ships in conformance with the Navy design specifications. Since 1967, however, the Navy has pursued the philosophy that contractors can effect savings by designing the vessels themselves, taking into consideration the peculiarities of their production facilities. The Navy has, on several programs, awarded contracts after a design competition in which the shipbuilders developed their own plans to meet the Navy performance standards. In the initial competition for the DD-963, six shipbuilding firms engaged in duplicate design efforts which involved literally hundreds of the nation's top engineers. However, only one firm was awarded the final contract. The demands which this revised ship design procedure places upon the supply of engineers is further accentuated by the profit premiums which the Weighted Guidelines award to contractors employing an engineering team.

3. The Effect of the Weighted Guidelines on Profit

In the absence of competition (and implicitly the absence of Scherer's competitive incentive), the Weighted

Guidelines and all profit schemes based on costs are vulnerable to the accusation that they provide a long-range incentive to increase cost. In the absence of competition, a contractor will find no reason to lower his cost estimates or to implement cost reduction programs. As was shown earlier, there is a very narrow range within which profits have been negotiated despite variations in cost composition. As a practical matter then, it probably can be assumed that profit maximization depends largely on maintaining contracts with the government based on the largest cost base possible.

Indeed, in the case of shipyards, maintaining a monopoly position, there is little to motivate them otherwise; profit maximization in an atmosphere of relatively fixed profit/cost ratios is dependent upon cost maximization. Incentive contracts, which may effectively promote lower costs on a single contract, are unlikely to motivate the monopolistic contractor to undertake any investment which will weaken the negotiation position on future contracts. Each completed contract builds the data base which will be used for future negotiations. In the simplest terms this means that if a contractor builds a submarine on this year's procurement at a cost of \$10 million below the target price, the target for follow-on procurements could be \$10 million lower than on the initial buy. Other factors, such as inflation, the learning curve, changed specifications affect the price of the new system; but the costs and the schedules of previous efforts become the basic pricing assumptions of subsequent negotiations.

Contractors recognize that any investment which reduces total cost can, over the long run, reduce profit. Cost incentive contracts can only provide impetus for substantial investment in cost-reducing capital equipment under some very special circumstances. The contract must be of sufficient duration to assure that the contractor will be able to recover enough profit through the incentive scheme to offset (1) the initial investment and (2) the discounted value of future profits foregone by lower cost estimates on future contracts. Multi-year procurements possibly provide some motivation to invest through cost incentive contracts even in the absence of competition.

Where competition is present, it provides the "competitive incentive" wherein the alternative to invest may entail losing a vital contract. Price competition between two contractors can provide a powerful incentive to invest in cost-reducing equipment, as discussed in the previous section.

It is unreasonable to expect contractors to reduce cost if, by so doing, they will reduce their profits. It is even more absurd to expect that contractors would increase their investment to effect a cost reduction if the net result is a lower level of profit. Under the Weighted Guideline scheme each dollar invested has a negative marginal revenue product; no rational businessman would increase his investment under these conditions. Managers ultimately are held responsible to stockholders principally on the basis of

rate of return. If a contractor is faced with the conditions imposed by the Weighted Guidelines, (i.e., fixed profit/cost ratio), he can improve his rate of return in two ways: (1) by increasing his costs or (2) by decreasing his investment. The end object of the investor, to maximize the rate of return on his invested capital is incompatible with the cost minimization goal of the government. The Weighted Guidelines and profit, therefore, provide a powerful but unfortunately a perverse incentive on system cost.

4. The Effect of the Weighted Guidelines on Mobilization

Assuming that the goal of a firm is maximization of rate of return, it has been demonstrated that basing profit on costs provides the firm with a powerful incentive to disinvest. If competitive effects can be ignored, the firm having the lowest ratio of capital to costs would have the highest rate of return. However, the long range objective of firms must account for the action of competitors if entry into the industry is possible. To assure its continued position in the industry, the firm must insure that it adjusts its plant size to produce the quantities being demanded at a competitive price. Failure to do so may mean that the company loses its market and ceases to exist. For this reason, strong shipbuilding firms reacted to the prospect of greatly improved demand for shipping in the late 1960's by increased investment. This action does not imply that the optimum allocation of capital and labor results. If the Weighted Guidelines has any effect at all upon the contractor's

investment decisions, it must be assumed that profit on cost biases the contractor allocations in favor of labor. That is, even though contractors are expanding their plants, they are doing so despite the WGL incentives to keep the capital base at nominal level. Since the nation's mobilization ability is primarily a function of industrial capacity, lower than optimal level of capital is implicitly the equivalent of a suboptimal mobilization base. The effects of the WGL compounds the influence which the low level of profits discussed in Chapter II. has upon the incentive to invest and consequently upon mobilization posture.

5. The Effect of the Weighted Guidelines on Firms with Different Capital Turnover

In standard accounting texts the measure most frequently endorsed as the best single indicator of the profitability of the firm is in the ratio referred to as return on investment. There are subsidiary ratios which are factors of return on investment: Operating profits and Investment Turnover.⁽⁵³⁾ That is:

$$\text{RETURN ON INVESTMENT} = \text{INVESTMENT TURNOVER} \times \text{OPERATING PROFIT RATIO}$$

or

$$= \frac{\text{SALES}}{\text{TOTAL CAPITAL INVESTED}} \times \frac{\text{INCOME}}{\text{SALES}}$$

As Anthony states in his text:

Many consider this (return on investment) to be the most useful way of looking at the overall performance of a business. It shows that performance can be improved either by generating more sales volume per dollar of capital employed or by increasing

the profit margin on each dollar of sales generated. It shows that a supermarket earning 1 percent on sales may be doing as good a job for its investors as a department store earning 10 percent when the supermarket has an investment turnover of twenty and the department store a turnover of two. (54)

An LMI study of the weighted guidelines makes a similar argument: (55)

It is universally agreed in financial management circles that a percentage of profit on sales or costs is significant only within a group of homogeneous operations. There is no necessary consistency between the rate of profit on costs in one kind of business or company financial structure and that in another.

The incredible fact is that the weighted guidelines and all other profit systems based solely on costs are implicitly ignoring the effect of the capital turnover on profitability.

B. BRITISH DEFENSE INDUSTRIES

The philosophy of the British Government vis-a-vis competition in its defense industries differs sharply from that of the United States Government. The British military budget is no longer designed to support its once expansive holding, consequently, fewer firms are required to fulfill the needs of the British military forces. New weapons system developments would have to be fewer and the production runs shorter. Realizing this, the British Government has pursued a policy of encouraging mergers and consolidation in both aerospace and in shipbuilding industries. What has resulted, in effect, is a series of government-controlled monopolies which operate under a set of rules which guarantee them a moderate rate of return. That the arrangement does

not arouse the passions of opposition which it surely would prompt in this country is largely a reflection of the different economic paths which the two countries have followed in the decades since World War II; Britain's Labor Government has nationalized many of the capital industries (coal, steel, railways). The familiarity of the British people with these national monopolies has gradually eroded any psychological barriers which existed to the idea of a nationalized industry. The mergers which occurred merely brought the institutional firm in to concert with the economic facts. Competition has not played a role in assignment of weapon system contracts for a decade; contracts have been awarded on a quota basis.

Faced with this economic structure, the British developed a system which would assure the existence of the few remaining firms in the defense industry by providing what amounts to a guaranteed rate of profit on capital invested.

Expressed in its simplest terms, the British profit works as follows. There is an annual calculation of the average capital employed which includes both the owner's equity and a computed figure for debt financing employed. This figure is then used to compute the turnover ratio based on the previous year's sales volume. The resultant figure is substituted into a formula virtually identical to the return on investment formula used in the previous section. For example, if a firm with Average Capital Employed of \$100 million had costs of \$160 million, its turnover ratio is 1.6.

Using the formula:

$$\text{Government Profit Standard (GPS)} = \frac{\text{Profit on Cost}}{\text{Turnover rate}}$$

where the GPS is 10%

$$\text{Profit objective} = \frac{1.6}{.10} = 1.6\%$$

The Government Profit Standard is calculated periodically to reflect the average earnings on assets being experienced in the British industry. (56)

The resultant figures are adjusted for unusual risk or efficiency. Once computed, the profit objective applies to all contracts awarded during the next year. The government selects the profit standard and adjusts it to conform to industry-wide averages on the basis of periodic reviews. No consideration is given to the contract costs in setting profit objectives.

The British experience with this system has not been an unmitigated success. The accusation is frequently made that the system provides no incentive by industry to invest in capital equipment that would reduce overall capital requirements. Profits based entirely on capital encourage inefficient use of that capital.

Earning stability is one of the benefits most frequently cited by advocates of ROI - based profit systems. Yet the British experience indicates that profits based on return on investment are not significantly more stable than those based on cost. (Table X)

TABLE X.
RATE OF RETURN ON NET ASSETS IN U.S. AND
U.K. AEROSPACE FIRMS⁽⁵⁷⁾

<u>Year</u>	<u>U. S.</u>	<u>U. K.</u>
1956 - - - - -	.345	.185
1957 - - - - -	.313	.157
1958 - - - - -	.226	.126
1959 - - - - -	.137	.106
1960 - - - - -	.103	.094
1961 - - - - -	.143	.059
1962 - - - - -	.181	.070
1963 - - - - -	.164	.087
1964 - - - - -	.182	.063
Average - - - - -	.199	.105

This instability probably stems from the mechanics of the British approach rather than from inherent weakness in the concept of asset-based systems. The British base the turnover ratio to be applied in next year's computation on the current year's data. As long as sales are not stable, the actual turnover ratio will differ from the turnover ratio being applied. Consequently, in time of rising sales the profit will be higher; when sales fall from year to year, profit will follow it down.

The British, in their system, make no attempt to apportion the capital base to individual contracts. The target profit on contract cost is applied to all contracts without regard to the proportion of the capital base they employ. Since the capital intensities of various projects differ, a firm will make more than the target rate of return (on assets).

Despite the inaccuracies of the British system, it does have an appealing simplicity of application. However, the factor that makes it simple makes it unadaptable to the American situation. The American public harbors an aversion to the concept of guaranteed profits for defense contractors, which is a clear premise of the British profit system.

C. REGULATED INDUSTRIES

In the American Economy, public utility status has been chiefly imposed on those industries which exhibit decreasing average cost to scale. The economies of scale make it possible for a large producer to produce at a lower cost than his smaller competitor. This often gives the larger producer the advantage of pricing his product below the costs of his competition thereby forcing some of the competition out of the market. A decreasing average cost industry is commonly referred to as a natural monopoly.⁽⁵⁸⁾ The government, recognizing the need to exploit the economies of scale, has licensed certain regulated monopolies to provide our electric power, telephone, communications, etc. By so doing, the government has also assumed the role of deciding what profits the investor in these industries should receive to compensate him for his opportunity cost of capital while denying him monopoly profits. The device used to accomplish this end is the rate charge on the service provided. Utilities are allowed to charge their customers an amount sufficient to reimburse all their costs and provide a "fair

rate of return on the capital invested."⁽⁵⁹⁾ As portrayed in Chapter II, a monopoly may occur in the defense shipbuilding industry when a particular shipbuilder has no immediate competitor in a specialized field. Although the United States Government has long pursued policies designed to promote vigorous competition among defense contractors, such monopolies still prevail in several sectors of the defense industry. Their existence makes it advisable to examine the experiences of the public utilities industry regulation to see what problems and promise it holds.

The profit scheme used in utility regulation is somewhat similar to those proposed for certain contract types in the defense industries. A defense monopoly, in a negotiated cost-reimbursement contract, is reimbursed all of his cost and is provided a profit above the cost; a situation not unlike the public utility contract procedures.⁽⁶⁰⁾ The distinction between the two lies chiefly in the degree of stability in the demand for their products. Public utilities can rely on predictable demand for their products, whereas the government's requirements of the defense contractor have been known to fluctuate widely. Then, too, the monopoly position of the utility is usually guaranteed by the regulatory body. A monopolist in the defense industries must be alert to the possibility that a competitor might gain entry into his market. Both of these differences contribute to make the position of the monopolist in defense industries considerably riskier than public utilities.

The literature in the economics of utility regulation since 1962 has centered on a theory advanced by Harvey Averch and Leif L. Johnson.⁽⁶¹⁾ Their assertion was that regulation-based rate of return stimulates excessive use of capital and leads to unfair competition in related markets. The excessive concentration on capital is illustrated in Figure 9.

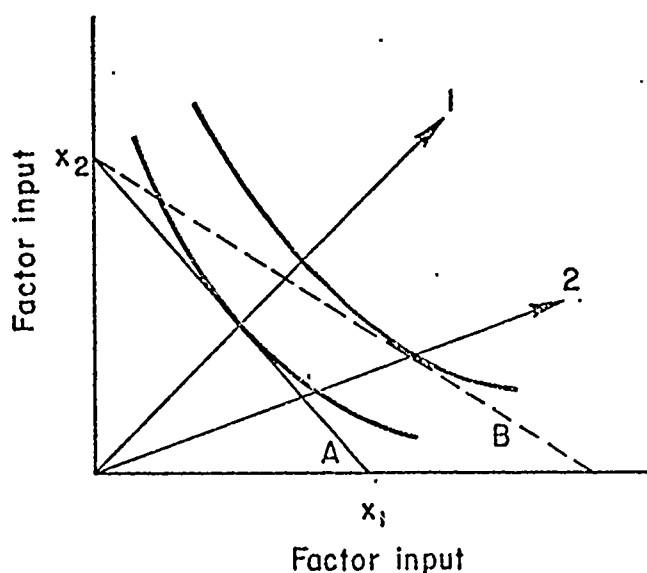


Figure 9.

Figure 9 denotes the firm's production where capital, x_1 , is plotted on the horizontal axis and labor, x_2 , is plotted on the vertical axis. The market generates the isocost curve A and the unregulated firm would move along the expansion path 1 where market cost is minimized for any given output. With regulation, however, the cost of capital to the firm is no longer equal to market cost. For each additional unit of capital input, the firm is permitted to earn a profit (equal to the difference between the market

cost of capital and rate of return allowed by the regulatory agency) that it otherwise would have to forego. Therefore, the cost of capital is less than market cost by an amount equal to this difference. The effect of regulation is analogous to that of changing the relative prices of capital x_1 and labor x_2 . Isocost curve B becomes relevant and the firm moves along expansion path 2, a path along which market cost is not minimized for any given output. Since profit is paid on the basis of the facilities and equipment (the rate base) of the producer, expansion path 2 is advantageous to the firm. The regulations, in effect, make it more profitable for the producer to employ capital than labor; the firm thus becomes more capital intensive.

This substitution of capital for labor, ignores the true relationship between the marginal productivities of the two factor inputs. It rewards the producer for employing additional capital when increased labor would provide the same output at a lower cost. Averch and Johnson therefore concluded that the regulation of utilities based on return on capital results in misallocation of our resources.

A second criticism of the asset-based regulation concerns the behavior of a monopolist operating under public utility profit regulation when he enters other markets. Averch and Johnson theorized that the monopolist would have an incentive to expand into other regulated markets, even if it operates at a (long run) loss in these markets. Therefore, it might

drive out other firms, or discourage their entry into these other markets, even though the competing firms may be lower cost producers. Considerable empirical evidence was presented which supported the conclusion that some public utilities did compete unfairly in some markets. Since they were guaranteed a fixed profit on the rate base, any income on other products (or services) which exceeded their variable cost would add to their income. In this way monopolists were given the ability to undermine the competitive situation in other markets. This facet of the Averch and Johnson theory has important implications for shipbuilding. Assuming that the shipbuilders' aim is for a profit equal to a fair rate of return on investment, a profit on capital approach would provide incentives to pursue discriminatory contract pricing similar to that employed by public utilities. The danger also exists that the shipbuilders would be exposed to the pressures discussed above to inflate their rate bases by inefficiently substituting capital for labor. Given the differences between the utilities market and the defense market, it would be unwise to conclude that firms in the defense market would follow the same pattern as the public utilities, but an alertness to that possibility would be prudent.

D. THE IAC SUBCOMMITTEE PROFIT METHOD

1. Introduction

The IAC Subcommittee, meeting in 1970, had the benefit of several years of study by the Logistics Management Institute,

the ASPR subcommittee, and various private individuals. This provided a wealth of analysis on which to base conclusions and recommendations. The method of profit computations which the IAC Subcommittee recommended combined the weighted guidelines system with some of the features of the asset-based system. The recommendations of the IAC Subcommittee have already been embodied in two proposed ASPR revisions, one of which will possibly be enacted in the summer of 1972. The unique features of the IAC Subcommittee proposal are:⁽⁶²⁾

- (a) Equal consideration of profit on cost and profit on capital,
- (b) Explicit treatment of the capital turnover,
- (c) Development of weighting factors for capital similar to that applied to cost.

The following excerpt from the IAC Subcommittee report describes the mechanics of the approach.

"Contracting officers would make two computations to determine the government prenegotiation profit objective.

1. The Weighted Guidelines profit on cost computation would be calculated as it is now calculated, except for the deletion of one factor, Source of Resources, from the computation. This was the factor that was designed to recognize contractor capital employed and has proved ineffective. Other than that, this computation remains the same.
2. The contractor capital employed computation would proceed as follows:
 - a. The total dollars for each of the four classes of capital -- operating

capital, land, buildings, and equipment -- allocated to the contract would be multiplied by a weighting factor which expresses the different risks and preferences for one class of capital compared to other classes. The weights are as follows:

Operating capital	.7
Land	.7
Buildings	1.0
Equipment	2.0

The reasoning behind these weights and their mathematical derivation are discussed in a later section. It is only important at this point to understand that the weights change the basis for computation of the profit on capital from essentially raw data to a weighted capital employed. An example of this computation is as follows:

<u>Class</u>	<u>Input Dollars</u>	<u>Weight</u>	<u>Weighted capital employed</u>
Operating capital	\$ 6,000	.7	\$ 4,200
Buildings	1,500	1.0	1,500
Equipment	2,500	2.0	5,000
Land	400	.7	280
	<u>10,400</u>		<u>10,980</u>

- b. The weighted capital employed would then be divided into the estimated contract costs to obtain capital turnover.
- c. The capital turnover number derived above is divided into a predetermined rate of profit on capital, which will be equal to the most recent four-year average of the realized return on capital invested by the FTC-SEC sample of companies in the durable goods industry, the most nearly similar group to defense contractors. To the profit on capital of this sample of commercial firms will be added a 3% adjustment for unallowable costs. The resultant standard is now 22%. Dividing the profit on capital by the capital turnover will translate the profit on capital to profit on cost.

3. The two profit computations above are then averaged with a .5 weight on cost and a .5 weight on capital.

The entire equation in the proposal would appear as follows:

$$\frac{\text{Capital Adjusted}}{\text{Profit Objective}} = .5 \times (\text{WGL Profit Objective})$$

+

$$\frac{(.5) (22\%) \text{ contract costs}}{\text{contract capital}} (63)$$

At least three questions must be posed about the method presented above:

(a) What preference weights are assigned to the four classes of capital?

(b) Why was durable goods chosen as a standard of profit?

(c) How much weight should be placed on the cost based calculation and how much on the asset computation?

2. Preference Weights on Capital

The weights provided to the various classes of capital represent subjective judgments of the relative amounts of risk in the various asset classes. These weights also reflect the IAC's opinion of the relative benefit of the various asset classes in reducing contract cost. This is an attempt to reward investment in cost-reducing capital equipment which tends to be riskier than land or inventory.

3. Selection of the Profit Standard

The choice of the durable goods profit experience was based upon the realization that the defense industries

must compete with the civilian sector for resources. Unless the profits in the defense sector are comparable to those available in the market place, defense will not be able to draw the necessary means of production away from the civilian sector. The durable goods industry was chosen because it is most similar to the type of manufacture which defense firms undertake. Although the IAC Subcommittee recognized that this standard was imperfect, it contended that there was no perfect standard available. The Subcommittee stated the following justification for its choice:

"The rate of profit that DOD should allow in the profit objective for contractor capital invested in a defense contract is especially perplexing because there is no absolute standard which represents an equitable return on capital. It would be circular reasoning to use defense contractors' prior profit rates on capital employed on defense work to establish a competitive figure. Nor would it seem acceptable to use a single company's profit rate on commercial work as DOD's profit objective for negotiating with that company.

The Profit on Capital proposal would use as a profit standard the return on capital earned by a sample of FTC-SEC Durables from 6 SIC Codes. This standard is a comparison, or relative standard; and, as such, is imperfect. Valid questions can be raised over the comparability of this sample of commercial durable goods firms with Defense contractors. Yet, the authors of this proposal claim that the use of the sample of FTC-SEC Durables as a profit standard is rooted firmly in the argument that defense firms compete for capital in the free market place; and therefore, if they are to stay in business, must earn a return which approaches parity with that earned by the most comparable commercial firms. Both a public obligation for equal treatment and practical inducements to invest capital in defense require this."(64)

4. Weight on Capital vs Weight on Cost

The recommendation that the profit objective should reflect the capital invested (more accurately, the capital

turnover) and contract costs was based on some sensitivity tests which the IAC Subcommittee conducted. It was found that using a 22% Standard of Profit, the 50% on Capital/50% on cost weighting produced overall return on capital figures which the Subcommittee deemed reasonable.⁽⁶⁵⁾ The rationale for retaining some weighting on cost was more precisely defined. It was reasoned that the straight return on capital model tends to (1) produce a guaranteed fixed return on capital, and (2) provides no incentive to be efficient in the use of capital. These effects, and the desire to reflect the magnitude of the undertaking in the profit awarded led the IAC Subcommittee to its recommendations.⁽⁶⁶⁾ The proposed ASPR revisions have adopted the IAC Subcommittee report method with a single change; the recommendation that the range of profits be varied to reflect the degree of risk in the contract. The standard of profit will range from 20% for Cost Reimbursement to 32% for Fixed Price contracts. This provides the contractor with an incentive to pursue contracts in which he assumes a greater risk.

F. POSSIBLE FAILINGS OF THE IAC SUBCOMMITTEE REPORT METHOD

A government profit policy is only effective to the extent that (1) the profit negotiated matches the actual profit result and (2) the contractors are stimulated to take individual actions which are in the best interests of the government. Department of Defense experience with multiple

incentives has shown that the complex forces acting upon a contractor may foster results which are counter to the Government's objectives. Economic texts abound with warnings of the potential hazard involved in tampering with market mechanisms. However, the choice facing the government is not between the market mechanism and an artificial profit standard. The government is forced to regulate prices in many defense markets where competition, the market mechanism, is regrettably absent. The question then becomes this: what artificial mechanisms can be introduced to obtain the desired results with a minimum of disruption to the market place? There is no universal answer to this question, but an examination of the failings of systems previously applied might provide a first step in the development of a workable system.

In the analysis that follows, it is not the intention to equate any American shipbuilding firm with regulated monopolies. What is intended is an examination of the problems and the inequities which have occurred in the long history of regulated profits in public utilities. This could provide some forewarning of similar difficulties which might occur in the defense sector. Although the utilities' history of problems may not repeat itself in shipbuilding, the possible implications should not be ignored.

1. The "Fair Rate of Return"

The initial question to be addressed concerns the validity of establishing a profit standard. The market

forces, in a fully competitive system, will establish the prices for industrial capacity using the same laws of supply and demand that set the values for more mundane commodities. Capacity is the measure of supply in the manufacturing sector. Excess capacity means that the manufacturer has available service which it has not committed to the market at the prices being offered. If the government, or any other customer, seeks to obtain use of these resources, theoretically any price offered which exceeds the contractor's variable costs would be sufficient. (This ignores the contractor's perception of future demand which may raise the opportunity costs.)

The fully competitive model stated above requires surprisingly little modification to portray the forces at work in the competitive sector of the shipbuilding economy. Assume, for the moment, that the government extends a request for proposals in a competitive situation for which it intends to pay a return of 22% (on capital). If excess capacity is prevalent in the market place, the contractors will underbid the proposal to insure that they receive the work. Even if the contract is unprofitable on the basis of fully allocated cost, it will be a desirable contract for the shipbuilder as long as his variable costs are met. On the other hand, if the shipbuilding industry is operating at capacity, then offering a return which reflects the resolution of market force in another industry is unlikely to be a

sufficient incentive to draw the now scarce capacity away from more profitable shipbuilding contracts. Therefore, it is likely that attempts to impose a profit standard on a competitive industry will prove futile.

It has not been the objective of the government to impose its WGL/ROI scheme on markets where strong competition prevails. Even the GAO, which has been one of the more staunch advocates of the asset-based profit system, recognized that this system was appropriate only for "negotiated government contracts where effective price competition is lacking."⁽⁶⁷⁾ However, a close examination of the possible results of applying a profit standard to the monopolistic firm reveals several undesirable side effects in this procedure. If demand for shipbuilding capacity is depressed, then only those firms with a market position which excludes competition will be able to benefit from the government profit standard. That is, under the IAC Subcommittee proposal, firms in a monopolistic position will be offered a profit level based upon the conditions prevailing in durable goods which has been consistently profitable, when the opportunity cost for the use of his facilities may be zero! Naturally, the monopolist will accept. Recall from Table VII that the shipbuilders who are active in the restricted markets are also active in the competitive markets. Thus, they alone can benefit from the profit policy when excess capacity prevails.

When the demand for shipbuilding facilities is high, the profit available on commercial work will climb. Therefore, a profit standard based on some other industry which may not be experiencing a boom (e.g., durable goods) will be insufficient to draw away resources in the monopolistic market, as it did in the competitive model. A particularly forceful example of this effect is provided by the action of General Electric and Westinghouse with regard to the Rickover Navy's nuclear submarine contracts in the 1960's.⁽⁶⁸⁾ Because the Defense Department would not offer these manufacturers the equivalent of a 25% return on their investments annually as was available in the civilian market, both of these manufacturers refused to bid on the Government request. Their position as the only contractors capable of answering this pressing national need was not sufficient to cause them to ignore the higher profits available in other industries. A proposal which allows explicit consideration of the opportunity cost of capital is advanced later in this thesis.

In summation, the adoption of a profit standard based on an average external to the market concerned is likely to alter the normal course of the market mechanism in only one case; it will aid the monopolistic shipbuilder in a depressed market. The desirability of this effect is an open question.

2. Implication of the Averch-Johnson Effect on Monopolistic Shipbuilders

There are three issues which Averch and Johnson⁽⁶⁹⁾ pointed out in the regulated industries that have bearing on

the behavior of the monopolistic producer in the shipbuilding industry.

The profit scheme in the regulated industries, which reimburses all allowable costs and pays a "fair rate of return on capital," permits a producer to be inefficient in cost and encourages him to be inefficient in capital. The IAC Subcommittee recommendation takes this undesirable incentive one step further. If a shipbuilder is secure in his position as a monopolist (i.e., he has no competitive pressures), he is provided an implied incentive to be inefficient in both cost and capital. Take, for instance, the case of the shipbuilder called Alpha who has no competition and who is operating under a cost reimbursement type contract. Alpha can increase his long-run profits in two ways: (1) by increasing the target cost on which his future WGL profits are based and (2) by increasing his asset base on which the ROI profits are based. The reductio ad absurdum of this IAC incentive scheme is illustrated by the type of action which maximizes Alpha's profit under these circumstances; Alpha should acquire very expensive capital equipment which is very inefficient for this type of operation involved. This would increase both his costs and his asset base. Although it is unlikely that the contractor would elect to make this economically unsound investment, the IAC Subcommittee's proposal provides implicit incentive to do so.

Averch and Johnson showed that the regulated industries have a tendency to become overly capital intensive in reaction to the government profit policy. The utilities recognized that there was no financial payoff for hiring labor when capital could do the job and substituted capital for labor at every opportunity. The proposed ASPR revision probably circumvents this particular failing by providing equal weight to capital and to cost. It should be recognized that even this 50/50 weighting arrangement still provides a bias in the direction of capital intensity. The cost factors include depreciation as a part of overhead; the weighted guidelines thus reflect material charges, overhead allocation, sub-contract charges and the subjective "below the line" weightings. All of these combine to dilute the impact of labor on the profit objective.

The IAC Subcommittee method still implies a substantial incentive for a capital intensive approach. In the presentation of its recommended weightings, the IAC Subcommittee did not reference any studies which had measured the stimulus to deviate from the optimal allocation of labor and capital. In industries which can produce their product most efficiently with a labor/cost of goods ratio of 70%, the incentive implied by the IAC method may lead to an inefficient substitution of labor capital. The testimony of RADM Nathan Sonenshein and several shipbuilders before the Sea Power

Subcommittee placed heavy emphasis on the inherently labor intensive nature of warship construction.

It is possible that a flexible weighting system which provides weights on capital and labor in proportion to some estimate of their optimum allocation ratios might eliminate this inefficient substitution. If the weights approximated this ideal, then the firm would be provided a stimulus to grow along the economical expansion path.⁽⁷⁰⁾ This is an area with possibilities for further studies.

The last possible problem surfaced by the Averch and Johnson article concerns the action of monopoly firms who also compete in competitive markets. The Newport News yard of the Tenneco corporation closely approximates this model. As Table VII shows, Tenneco alone is capable of competing in every market and is the only producer of aircraft carriers. Under the proposed ASPR revision, for example, Newport News would be paid a profit on aircraft carriers and submarine contracts based largely upon the pro rata share of its total capital base. These ASPR revisions would allow Newport News to select the standard for allocating capital to contracts (i.e., labor hours, machine hours, etc.). Since both submarine construction and aircraft carrier construction are particularly labor intensive, Newport News would wisely choose to pro-rate its capital on the basis of total labor hours. This would allow this shipbuilder to enter other markets which are relatively capital intensive (e.g., simple tenders, dry cargo ships, naval support ships, and shipping containers) and compete

... with a sizable relative advantage. The Government would be reimbursing Tenneco for depreciation (again pro-rated on labor hours) on all the equipment in the yard, including that used in the other market, and, in addition, be providing a return on this capital. Newport News could make substantial profit in this competitive market while selling well below its fully allocated cost of production. In this way a firm with a monopoly position in one market is provided the means of restricting competition in other markets.

The trend toward conglomerate control of shipbuilding has been pointed out previously. The government should be aware that even a well-designed, well-intentioned policy may have the effect of accelerating the concentration of control over the industry.

IV. PROGRESS PAYMENTS

A. INTRODUCTION

ASPR describes progress payments as "payments made as work progresses under a contract, upon the basis of costs incurred, or percentage of completion accomplished, or of particular stage of completion."⁽⁷¹⁾ Progress payments are one of five financing methods offered by the Government. After private financing, progress payments are the most preferred of the five methods which were mentioned in Chapter I.

This chapter discusses current shipbuilding progress payment procedures and a proposed change in that payment method. Financing methods other than progress payments will not be reviewed in this thesis.

B. BACKGROUND

1. Reasons for Progress Payments

The Department of Defense desires to buy the best weapon systems possible for the taxpayer's dollar. It desires that the best qualified contractors be motivated to bid on Government work. But what contractor can raise millions of dollars to build a system for which he may not be paid for two to five years? If a prospective contractor desires to bid on a contract with good profit potential but he can not raise the capital necessary or the cost of

capital is more than the profit obtainable, he will not bid on the contract. Further, if the fluctuations in the volume of business make it difficult for a contractor to continually adjust his capital structure or borrowings to cover peak financing requirements, he may avoid Government business. Finally, the Government is able to borrow money at a lower cost than private industry. These are four reasons why the Government provides financing through progress payments. The following paragraphs develop these reasons in detail.

The Industrial Advisory Council Subcommittee (IAC) reported that "the commercial banking industry can absorb an additional one to two billion dollars of total new credit requirements per year for both defense and non-defense users assuming the continuation of the present easy money conditions."⁽⁷²⁾ As shown below, the Navy alone has increased its expenditures for new construction hardware by approximately one billion dollars per year for the last four fiscal years. The applicable appropriations are Procurement of Aircraft and Missile, Navy, Shipbuilding and Conversion Navy, and other Procurement Navy.

TABLE XI.
(Millions of \$)

	<u>PAMN</u>	<u>SCN</u>	<u>OPN</u>	<u>TOTAL</u>	<u>DIFFERENCE</u>
1973	3871	3564	2023	9458	957
1972	3855	3005	1614	8501	1600
1971	3018	2465	1487	6901	307
1970	2620	2490	1481	6594	693
1969	2475	821	2506	5901	-

If progress payments were not being paid to contractors for the pursuance of this Navy work, the contractors would have to seek credit from financial institutions. There would not be any new credit left for other Government and commercial ventures in that case.

Financial decisions determine the contractor's cost of capital and therefore the required profitability of the investment as noted in Chapter II. Once this is determined, he can be expected to ration his capital resources among the most profitable projects. Only if the Government offers one of the more profitable projects available to the contractor, will he bid on it. Recognizing this, the Government pays progress payments for major contracts in order to help the contractor's cost of capital for Government business approach a par with the cost of capital for commercial business. He can, therefore, make a decision to bid on a Government contract because of his technical competence and will not be adversely biased by the financing requirements.

Corporations try to schedule their work in a manner that will optimize the allocation of their financial resources. Thus, a contractor will try to match his financing available to projected requirements. The volatile nature of the fluctuations in defense business for any one contractor makes this difficult. It is costly to continually adjust capital structure or borrowings to cover peak financing requirements.

Long-term debt financing is unavailable for ship-building contracts as discussed in Chapter II. But the assumption of short-term debt inevitably includes high cost and the risk of bankruptcy if cash is not available for the debt payments. It also includes a potential loss in flexibility because there exists a lesser capacity to assume additional debts. If the Government does not provide financing the contractor is forced to raise his capital resources by issuing stock or assuming more debt. The resultant higher costs and risks are reflected in the price of the products to the customer, in this case the Government. Although the Government does require legislative authority to increase the debt ceiling, it does not face either bankruptcy or loss of flexibility in the assumption of more debt. The Government prefers to finance a contractor through progress payments because the Government is able to borrow capital at a lower cost than private industry and because the cost of the product will be less as it will not include unnecessary finance and risk charges.

2. Reasons for a Positive Cash Investment by the Contractor

If the Government carried the progress payment and other financing methods to extremes, all financing costs and their attendant risks would be borne by the Government. It would seem advisable to cause the contractor to assume some part of the costs and risks to maintain a more "normal" business relationship with the Government. IAC provided four reasons why a prime contractor should have a positive cash investment.

"a. To the extent he invests in the inventory, the contractor absorbs part of the risk that the work in process may not be converted into finished goods, sales, and profit. The same logic that keeps prime contractors from granting progress payments to subcontractors indiscriminately should support the point that government dollars in the form of progress payments are invested at risk.

b. To the extent he is required to invest in his inventory, the contractor becomes constrained by the forces of the capital markets, both equity and debt, and thus his ability to perform the contract depends to a greater extent on the size and strength of his capital structure.

c. The fact that the contractor must invest in his inventory motivates him to optimize that investment, i.e., to evaluate tradeoffs between the economies of larger lot purchases on the one hand and increased cash resources which those larger lots require on the other.

d. The options available to the customer in the event of serious program difficulty are considerably reduced to the extent the government has assumed the financing burden of the work in process. In other words, if the program experienced a major failure, and the government had paid no progress payments, then termination for default could be accomplished with no loss of customer investment. If on the other hand the government finances approximately 75% of the work in process, that option in reality is non-existent." (73)

3. A Trade-Off: Progress Payment Procedures vs Contractor Investment

So far this chapter has discussed the reasons for progress payments in contradistinction to contractor investment. Though the two need not be mutually exclusive, the level of contractor investment is a function of the method, rate, and interval of progress payments as will be discussed in the next chapter. Unfortunately, there is no absolute standard for measuring the adequacy of contractor cash investment in inventory, any more than there are absolute standards of adequacy for any other financial activity of a business. Both the IAC and Navy Task Group analyzed the

tradeoffs. Their conclusions are found in ASPR and the Navy Task Group Report on Shipbuilding Progress Payments, discussed in later paragraphs.

G. CURRENT AND PROPOSED METHODS FOR PAYING PROGRESS PAYMENTS

1. Non-Shipbuilding Type Contracts

IAC studied Department of Defense contracts with Aerospace Industry data. In the area of progress payments they recommended the following:

"a. The usual progress payment rate for all contractors except small business should be 85%. The rate for cost reimbursements should be continued at 100%.

b. Liquidation should be standardized at the ordinary rate until the government and contractors can reasonably forecast expected profit. The government may then elect alternate liquidation.

c. Cost reimbursements and progress payments for in-house costs should continue to be paid on a cost incurred basis. Payment for materials, purchases, subcontract deliveries, progress payments to subcontractors, and other direct charges as listed on the request for progress payments should be based on cash disbursements.

d. Progress payments should be made no more frequently than bi-weekly.

e. Unusual Progress Payments should be continued in order to provide needed flexibility to the contract financing regulations. Preferably, unusual progress payments should be unusual in rate only, with no departure from the standards in the other 3 financing variables. This will help the government monitor the extent of unusual progress payments and avoid hidden inequities in practice, while still permitting more financing to contractors where necessary and reasonable.

f. DCAS should develop and present a plan to OSD to reduce the delay from the close of a progress payment period until preparation of a check. Results from the DCAS sample indicate that the delay can be reduced to between 11 and 14 days for those contracts which are paid bi-weekly or less. The DCAS investigation should determine whether the delay on all payments could be reduced to approximately 10 days.

g. Until it can be determined that inequities arising from payment frequency and payment delay can be overcome, and to avoid imposition of the additional accounting requirements of a cash disbursements policy on small business, the Subcommittee recommends small businesses continue to receive all progress payments based on costs incurred.

Further the Subcommittee recommends that section III of the progress payment form be optional for small business unless the government contracting officer elects to make this section mandatory. (74)

2. Shipbuilding Type Contracts

Under current regulations, progress payments for shipbuilding, ship conversion, alteration and repair contracts are paid on a percent of completion method. Until the performance of the contract is 50% complete, the Government, upon submission by the contractor of certified invoices, will pay progress payments at 90% of an amount determined by applying to the total contract price the percentage of physical progress in the contract. The percent of physical progress must be certified by the contractor and approved by the cognizant Supervisor of Shipbuilding. No payment is made in an amount which, when added to the total of all previous payments, exceeds the cost incurred plus five percent of such cost. These procedures also pertain to the second half of the physical progress of the contract, except that the Government pays 100% instead of 90% on an amount determined as above, less five percent of the contract price as adjusted. The five percent withheld, less certain reserves, is paid to the contractor upon delivery of the ship. The reserves are of two types: (1) to cover the correction

of contractor responsible defects, which is generally in the range of 1% to 3% of the contract price, and (2) to provide for final settlement of the contract in the amount of \$100,000.00 or 2% of the contract price, whichever is the lesser. ⁽⁷⁵⁾

The standard progress payment frequency is bi-weekly upon submission of certified invoices. It may occur more frequently if expenditures by the contract warrant and shall be based upon the total contract price as adjusted by authorized changes. ⁽⁷⁶⁾ Escalation of labor and material costs is paid quarterly. To the extent that such payments, when added to other payments, would exceed 100% of the incurred cost certified by the contractor during the first 50% of performance, or of 105% during the last 50% of performance, the payment of such excess are deferred. ⁽⁷⁷⁾

3. Highlights of the Study on Shipbuilding Progress Payments

One of the primary objectives of the study on Shipbuilding Progress Payments was to determine if the present method of making progress payments, based on a percentage of physical completion, was an accurate measure which could be efficiently and effectively administered and verified. The Navy Task Group thought that the present method could only provide an estimate of the percentage of completion. In actual practice the Task Group maintained that the criteria used to determine material progress was cost. ⁽⁷⁸⁾

The Navy Task Group analyzed fourteen shipbuilding contracts using FINMOD. They concluded that the present

percent of completion payment method does not do the following:

- a. provide an accurate measure which can be efficiently and effectively administered.
- b. require contractors to have a positive investment in shipbuilding contracts.
- c. provide equal treatment with respect to the manner in which progress is measured.
- d. provide comparable treatment for shipbuilding contracts and other supply type contracts.⁽⁷⁹⁾

The Task Group investigated other methods of paying for shipbuilding contracts. The strengths and weaknesses of each was discussed. They agreed with IAC findings and ASPR policy concerning progress payments at 80% of disbursements (85% for small business) and a payment interval of not less than bi-weekly. They concluded that a "payment system based essentially on a cost-incurred system used by the Defense Department for supply type contracts, with certain additions and adaptations for the peculiarities of the shipbuilding industry, would be feasible."⁽⁸⁰⁾ Further, they concluded that "no physical milestones could be adopted," but that "percentages of completion could serve as acceptable milestones."⁽⁸¹⁾ They recommended that the percentage of completion be retained as a bound for interim payments. This would provide a contractor with an incentive to bring his physical progress in line with contract cost. If, for instance, a contractor had incurred 20% of the total contract cost but only completed 18% of the physical work, he would be motivated to close the gap so as to receive the interim

payment which is to occur at the 20% (of cost) milestone. Given the inexactitude of the measurement of physical progress, the physical progress bound is intended to act only as a crude constraint to insure that the contractor makes progress roughly consistent with the payments made by the Government. The specific wording of the Navy Task Group proposal for interim payments is as follows:

"When the progress payments paid hereunder are equal to the percentage of the contract price shown in Column A, an interim payment will be made. Such interim payments will be an amount equal to the percentage of the contract price shown in Column B; less the amount of total payments theretofore made, provided that the physical percentage of completion, as determined by the SUPSHIP, is equal to a percentage of completion not less than the percentage shown in Column C; however, if the physical completion, as determined by the SUPSHIP, is less than the percentage in Column C, such interim payments will not be made until physical completion reaches the percentage shown in Column C. The following schedule is applicable to contracts which provide for 80% progress payments:"

<u>Interim Payment Number</u>	<u>Column A</u>	<u>Column B</u>	<u>Column C</u>
1	10%	12.25%	10.0%
2	20	24.50	22.0
3	30	36.75	34.0
4	40	49.00	46.0
5	50	61.25	58.0
6	60	73.50	70.0
7	70	85.75	82.5

* This percentage represents 98% of the percentage of completion determined by the dollar progress. On 80% progress payments based on costs, 12.5% of the contract would be reached when progress payments are equal to 10% of the contract price. ($12.5\% \times 80\% = 10.0\%$) (82)

For small business contractors with progress payments based on 85% of disbursement, the schedule above is modified appropriately. In view of the interim payments provided for in this proposed system, the alternate method of liquidation, discussed in Appendix A, will not be applicable to the shipbuilding contracts.

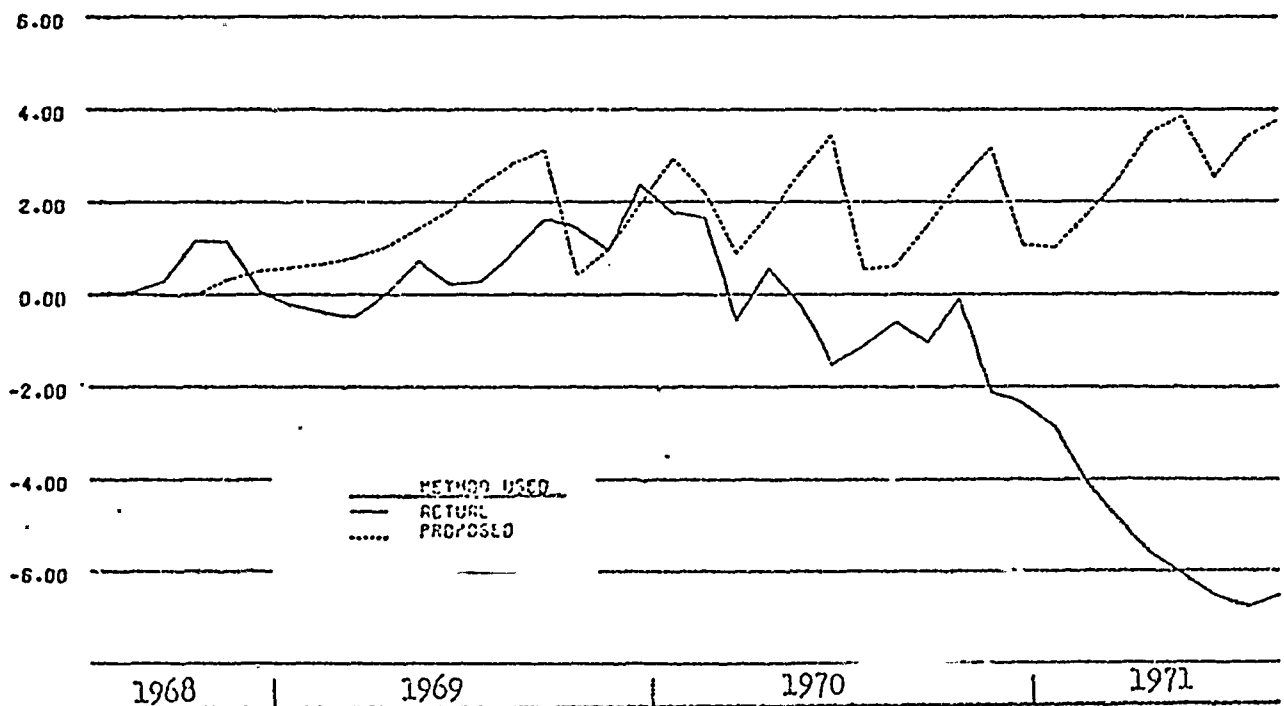
The timing and number of interim payments reflects the length of the contract life cycle. "If the period of time from the signing of the contract to delivery of the vessel is less than three years, only interim payments number 2, 4, and 6 will be made; if more than three but less than four years, only 1, 2, 4, 5 and 7 will be made; if more than four years, interim payments 1 through 7 will be made."⁽⁸³⁾

A performance reserve of up to 2% and a nominal percent of the contract price for preliminary acceptance of each vessel will also be paid when each vessel is delivered. The payment for preliminary acceptance can be as high as 4.5% for delivery of a vessel. Provisions are outlined for final acceptance of any separately price line item other than the vessel. For further detailed description of the Navy Task Group method, the verbatim proposal is provided in Appendix B.

The following figures display the difference between the percent of completion method and the progress payment method proposed by the Navy Study Group. The names of the shipyard and contract numbers are withheld for proprietary reasons.

Figure 10 is a multi-ship contract which was over 80% complete and no ships had been accepted when the data was recorded. Under the percent of completion method, progress payments on the \$164 million fixed price incentive contract

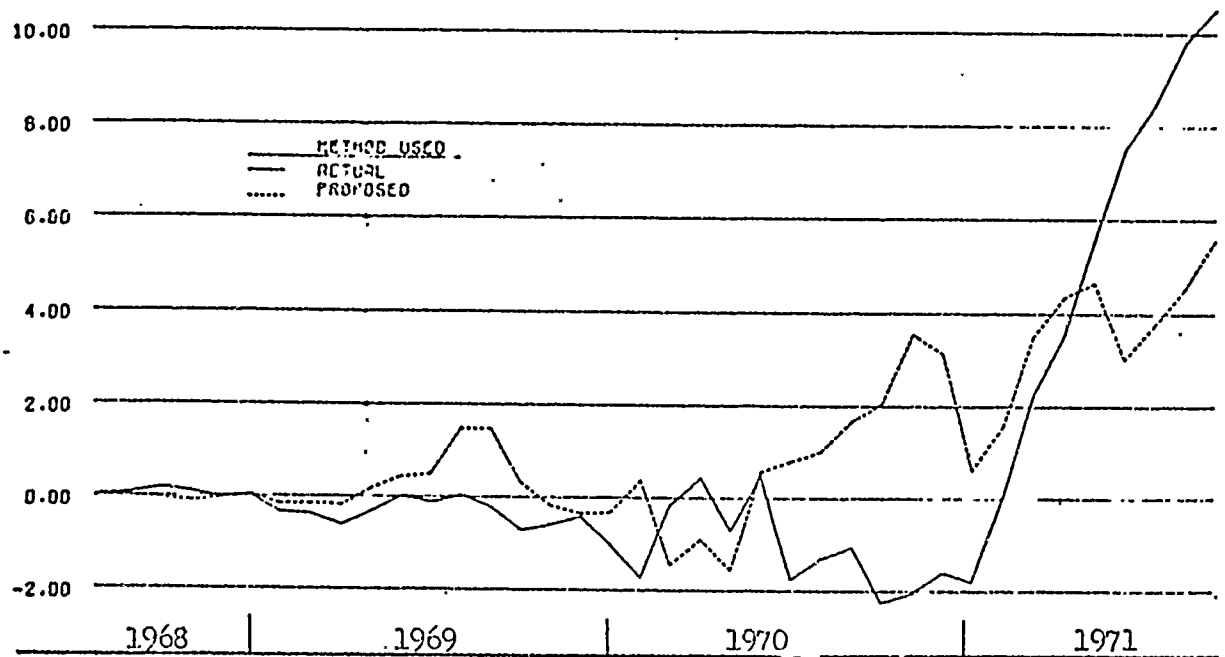
were paid weckly. There was substantial profit on this contract, and the contractor had a negative investment in the contract from early 1970 to the recordation date of the data. Note that at the end of the recorded life of the contract the contractor had over six million dollars of Government money to work with which was over and above what he had invested in the contract. When the biweekly 80% formula of the Navy Task Group is used, FINMOD shows that this same contractor would carry a moderately positive investment through the life of the contract.



Comparison of Contractor Financing Methods
For a Profitable Contract (Contract One)

Figure 10.

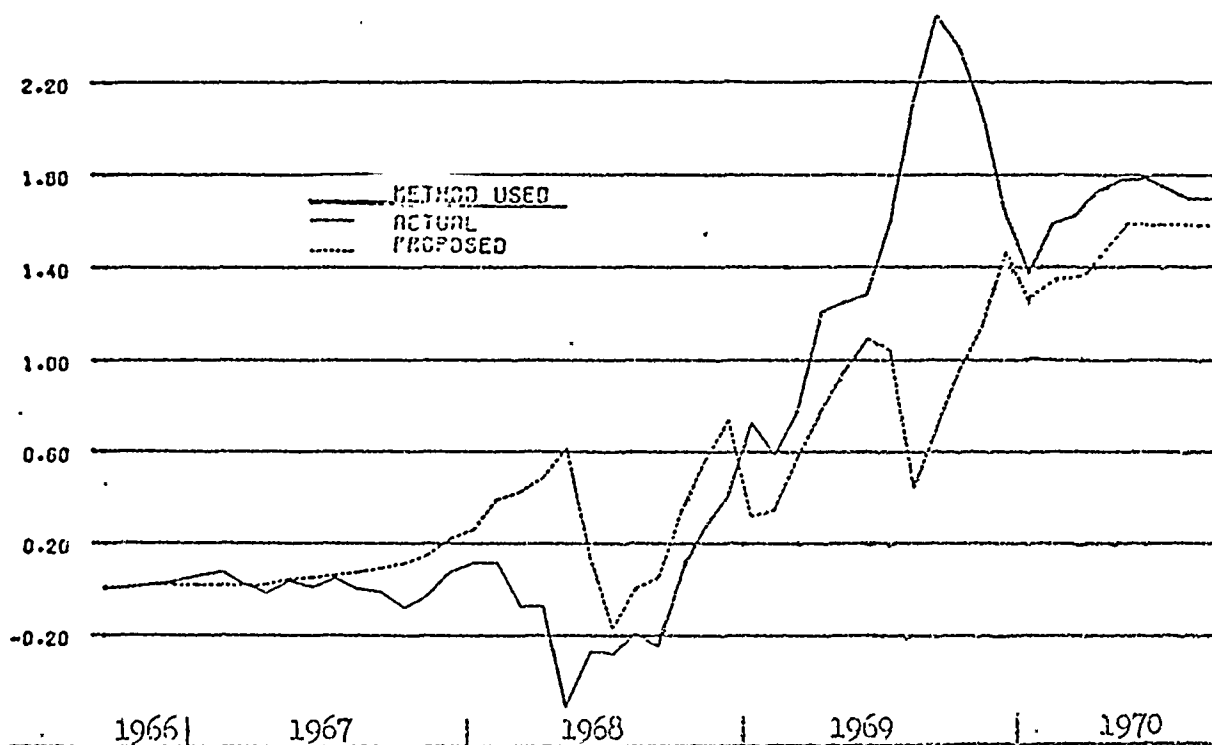
Figure 11 shows a \$108 million dollar multi-ship contract which was almost 70% complete. No ship had been accepted when the data was recorded. During the last eight months, the rate of physical progress had not kept pace with the costs, and the contract had gone into a loss situation. At the same time, the Government agreed to change from bi-weekly to weekly progress payments. Note how, at the conclusion of the analysis, the contractor had approximately eleven million dollars invested in the contract, and things were getting worse. This is the type of contract that can drive a contractor toward bankruptcy. Simulating the Navy Task Group proposal with FINMOD reveals that the oscillations of contractor investment are damped and the large positive investment near the end of the contract is at least moderated.



Comparison of Contractor Financing Methods For
an Unprofitable Contract (Contract Two)

Figure 11.

Figure 12 is for one ship priced at less than \$25 million. It has been completed and delivered but final settlement has not been made. Costs began to increase significantly in late 1968 without a commensurate increase in physical progress, thus causing a loss situation. Again the Navy Task Group method damps the oscillations and keeps the contractor in a slightly positive investment mode throughout most of the reported contract life.



Comparison of Contractor Financing Methods For an Unprofitable Contract

Figure 12.

V. CONTRACT DECISION ANALYSIS

A. ACM MODEL METHODOLOGY

Any attempt to develop a scale of comparability between government defense contracts and similar civilian business must compensate for two factors, government-owned facilities and the government method of payment. They greatly affect contractor investment requirements and, consequently, his return on investment. Use of an asset-based profit scheme accounts for the distortion introduced by government-owned facilities which allow higher profits for contractor-owned equipment. The need still exists to develop a method which will permit the government's agents (contracting officer and project manager) to consider the effect that various plans have on contractor investment and on his profits.

Shipbuilding contracts typically extend over several years with work in process representing millions of dollars. It is not unusual for the value of the work in process on a given contract, to exceed the net worth of the corporation; for example, on one recent contract, the cost of the contract was more than thirty times the stockholders' equity.⁽⁸⁴⁾ Because shipbuilding is more labor intensive than most defense business, the cash requirements for wages alone represent a substantial expenditure. Capitalized expenditures which would provide opportunity for chattel borrowing are

relatively few. Private borrowing to finance such immense projects would be out of the question.

The study of the Navy Task Group revealed that past variations in the level of contractors' investment have ranged from \$24 million to a negative \$22 million (i.e., in effect the government progress payments were \$22 million higher than the contractors net working capital requirements.)⁽⁸⁵⁾ The impact of these variations on contractor profits is potent indeed. It is the purpose of this section to develop a model which will do the following:

1. make explicit the level of investment in work in process which will be required of the contractor,
2. reveal the possible payment schedules which produce this level of investment,
3. measure the impact of the different payment schedules on contractors' profits.

Both the IAC and Navy Task Group proposals for progress payment procedures have significant impact on contractor financing. In subjective terms, it is the basic purpose of both proposals that the contractor maintain a financial investment in the work in process which is sufficiently large to stimulate him toward timely delivery of the end items, yet not so large as to present impossible financing problems. Both proposals aim to avoid the financial windfall which has been provided to some contractors through negative financing (Figure 10). The method proposed can also cause the burden of an excessively large contractor

investment to be lessened for loss contracts (Figures 11 and 12).

One purpose of this chapter is to develop a system which analyzes the Navy Task Group's proposals. Sensitivity analysis is applied to both payment rate and payment interval to evaluate what effects these have on average investment and rate of return on investment. The method and results of analysis may be used by both policy makers considering the proposed Navy Task Group method and practitioners trying to negotiate fixed price type contracts.

1. Data Assumptions and Limitations

It has been assumed that the FINMOD accurately simulated the contractor net work-in-process and the sources of financing for the contracts reviewed. Since all three contracts were actually financed by the Government using the percent-of-completion method, it has also been assumed that the results, if accurate, describe the effect of using the Navy Task Group's proposed financing method.

Data for the three programs was collected monthly instead of daily. This was done for two reasons. First, the authors were able to decrease the amount of time needed to build the data deck by a factor of thirty. Second, it is more likely in a real world situation that a prospective contractor would provide cash flow information on a monthly or quarterly basis instead of a daily basis. These assumptions result in a limited variance between the FINMOD and ACM-1 output which is discussed in Appendix C.

2. Input to the Model

The Navy Task Group provided its report and the FINMOD output data for three fixed-price-incentive shipbuilding contracts. The data simulated the effect of the proposed Navy Task Group financing method on contracts that had actually been paid by the percent-of-completion financing method. The authors used the following data from the FINMOD printouts: creditor/labor financing, bank-float financing, and contractor net work-in-process. The latter gives the total amount of all costs to build the ships. This amount equals the total of all financing which includes progress and liquidation payments by the Government, float by the banks, accounts payable by creditors, accrued labor salaries, and working capital investment by the contractor. Since contractor net work-in-process actually equals the cost of the ships, it should be relatively insensitive to the financing method. The contractor's financing requirements can be derived by subtracting the amount of external financing (creditor, labor, bank float, and Government) from the net work-in-process.

A financing factor was provided by the Navy Task Group which took into consideration financing by material vendors. In the case of 80% progress payments, the rate was decreased by the financing factor in order to conform with the provisions of ASPR. This factor is artificially

introduced due to the difference between the actual payment method used in the ship contract (% of completion) and the method proposed. The amount of this factor for contracts in Figures 10, 11, and 12 is 0.012, 0.045, and 0.008, respectively.

A lag factor provided by the Navy Task Group accounted for the time between submission of the contractor's vouchers to the Government and payment to the contractor by the Government. The value of this factor for contracts in Figures 10, 11, and 12 is 2, 6, and 9 days, respectively.

The contract price did not remain constant during the life of any of the three contracts. To cause the program to accept this real-world occurrence, the contract price was changed once each year. For instance, on the four year contract in Figure 12, the prices were as follows: \$22,280,724; 22,599,712; 23,080,153; and 23,319,271. These amounts are the actual historical contract prices for contract 3; the prices include change orders.

3. Outputs of the Model

The first program, ACM-1, attempts to verify that the authors' computer program can approximate the output of the FINMOD. Unless this can be accomplished, sensitivity analysis done by changing the payment rate and interval would be suspect. The output of this program is the contractor financing requirements on a daily and cumulative basis. Curves proving that the ACM model closely approximates the results of FINMOD are found in Appendix C.

The second program, ACM-2, determines the average contractor financing, similar to that done by IAC and the Navy Task Group. Both determine the contractor's daily financing requirement as in ACM-1, and the cumulative financing burden is averaged over the contract life. A different average financing level is determined for various combinations of progress payment rate and interval. The results of ACM-2 are presented in the form of a family of curves to give the reader a perspective on the effects of payment rate and interval. The first family of curves, Figure 13, holds payment rate constant, varies payment interval, and determines contractor financing requirements. The second family of curves, Figure 14, holds payment interval constant and determines contractor financing requirements when payment rate is varied. The last family of curves, Figure 15, determines the set of payment rate and interval variables which will cause various levels of contractor financing.

The third program, ACM-3, represents an attempt to consider the entire investment payoff from the viewpoint of the contractor. It is based upon the assumption that contractors are interested in attaining some unspecified rate of return for the dollars which they invest in a particular undertaking. This rate of return varies from contractor to contractor depending upon his cost of capital, market position, and, most importantly, upon some judgment as to what return is reasonably available from alternative

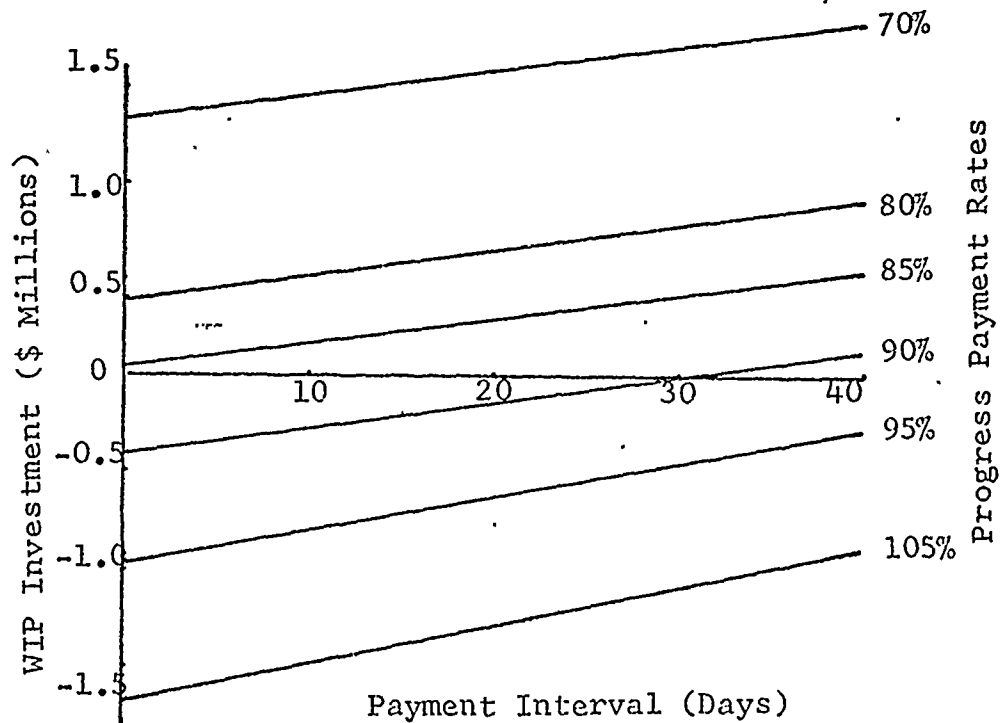
investments (i.e., the opportunity cost of capital). The model analyzes a discounted cash flow of the investments and receipts involved in a particular contract, accounting for the progress payment rate and interval chosen, and produces the rate of return which is implicit in that contract. As will be shown in this chapter, if the rate of return reflected by the model is not comparable to that prevailing in the market, some reexamination of the policy decision would be necessary. As in ACM-2, a family of curves is presented for ACM-3 analysis.

4. Analysis of the Program Output

a. ACM-2

The first set of curves displays the effect that change in progress payment rate has on the level of average contractor work-in-process investment. There is one curve reflecting each of the following rates: 105%, 95%, 90%, 85%, 80% and 70%. Ninety-five percent is the maximum rate which can be paid on the first half of a shipbuilding contract under existing regulations. After fifty percent of the ship is completed, the regulation permits raising the rate to 105%. Ninety percent is the rate customarily used in the first half of a shipbuilding contract. ASPR stipulates that 80% (85% for small businesses) will be the rate used for non-shipbuilding type contracts. Seventy percent is considered the lowest reasonable rate for purposes of this study.

ACM-2 curves shown below have been smoothed for clarity. For the contract three data used to develop these curves, the 80% progress payment rate curve causes the contractor to maintain a positive investment for any interval chosen.



Contractor's WIP Investment (\$ Millions)
vs Payment Interval (Days)-Contract 3
Figure 13.

Figure 14 contains curves which measure the effect of varying progress payment rates vs average contractor work in process investment for contract three. The payment periods chosen were those thought to be most prevalent in the shipbuilding industry. The three contracts

analyzed were paid on a weekly or bi-weekly basis. It is considered unlikely that progress payments would be paid at greater intervals than once per month on large contracts. The curves of Figure 14 demonstrate that the level of contractor work-in-process investment is not particularly sensitive to changes in the payment interval. At 80%, the increase of the payment interval from bi-weekly to monthly increments the contractor's WIP investment by $\frac{1}{2}\%$ of contract cost. In comparison, Figure 13 shows that an increase of the progress payment rate from 80% to 90% at a constant interval causes the contractor's WIP investment to decrease by 3.5% of contract cost.

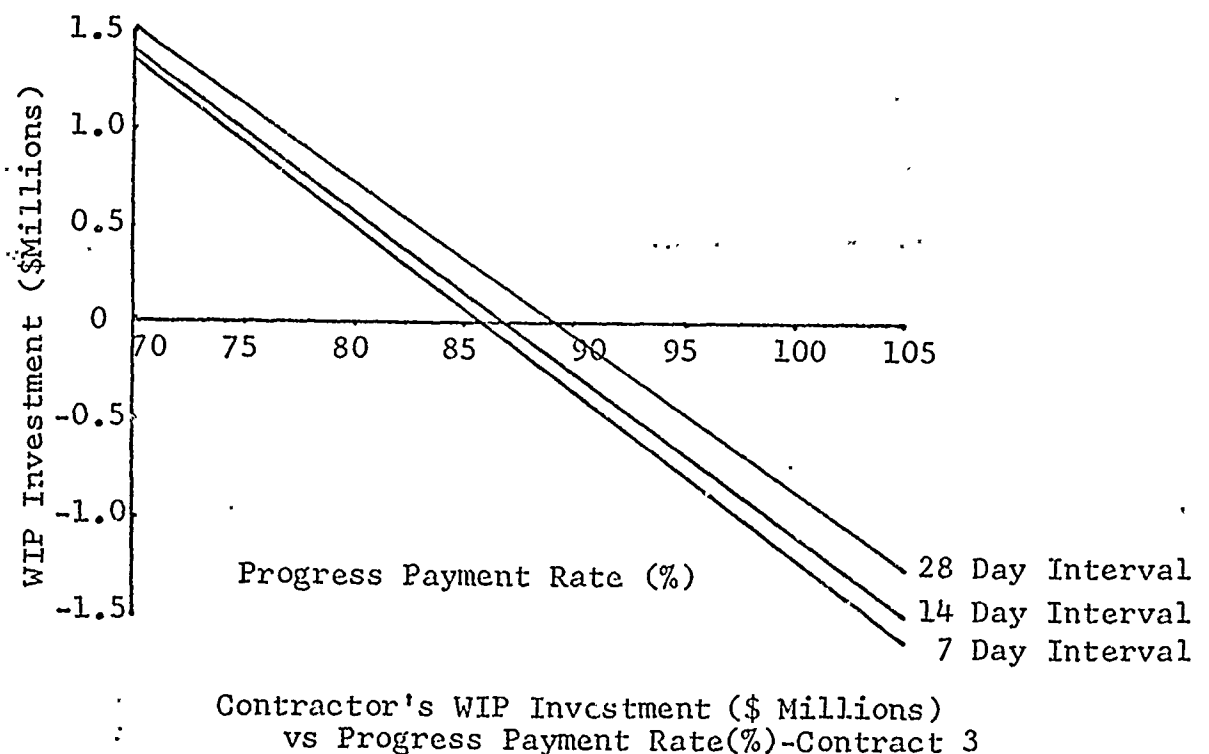
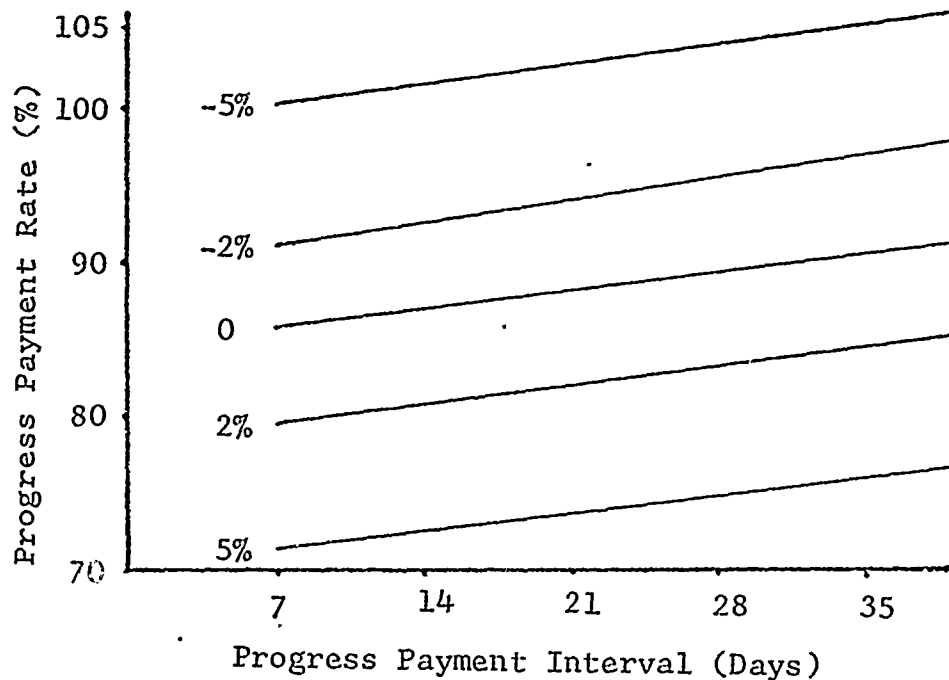


Figure 14.

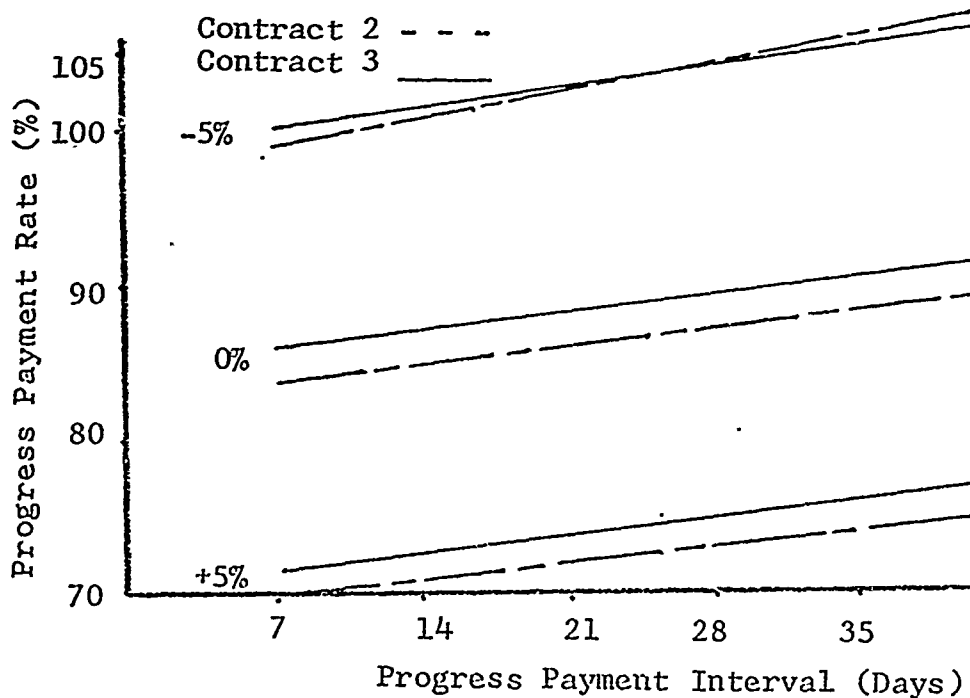
Figure 15 plots the combinations of progress payment rate and payment interval for various levels of contractor work in process financing. The contractor investment is measured as a percent of the total contract cost. Again, it appears that the level of contract work-in-process investment is relatively insensitive to payment interval when compared to payment rate. It is also noted that the slope of the investment curve remains constant.



Levels of Contractor WIP Investment
as a % of Contract cost for Contract 3
Figure 15.

Analysis of the zero, and five, percent investment curves for contracts two and three reveals that the levels of investment are approximately the same. Since the

curves of Figure 16 are almost on top of each other, the authors concluded from this small sample that the Navy Task Group method does consistently cause a positive contractor work-in-process investment.



Contract 2 and 3 Comparison of WIP Investment

Figure 16.

The usefulness of the curves in Figure 15 is that the Government can determine, by ex-ante analysis, what combination of progress payment rate and interval will give a desired level of investment. For example, if it is determined that it is in the best interest of the Government to cause a particular contractor to maintain a 2% level of

contractor financing, then 80% for seven days or 81% and 14 days are two of the combinations that will achieve that objective.

b. ACM-3

Program ACM-3 is directed toward a different type of analysis. Whereas ACM-2 measured the contractor's work-in-process investment as a percent of the contract cost, ACM-3 focuses on an analysis of the contractor's return on capital investment. The program output is the time adjusted rate of return which considers the contractor's capital investment through the life of the contract, the average level of work-in-process investment, and the time value of the cash flow of disbursements and receipts.

The time adjusted ROI is calculated in the following manner. The contractor's payments, including the disbursements and the capital base dedicated to the contract at its initiation, are compared to contractor receipts. Receipts include progress payments, interim payments, final payments, and the recovering of the undepreciated portion of the capital base. Interim and final payments include profit. The timing and amount of payments are computed according to the Navy Task Group procedure. This derived discount rate is the ROI at which the contractor will be indifferent to the investment opportunity that the contract offers. If the contractor can normally expect contracts that offer a higher profit on his capital investment, then

he would not normally bid on a contract with this lower ROI. A reader unfamiliar with discounted cash flow techniques may refer to Bierman and Schmidt.*

Empirical data was not available on the amount of capital investment dedicated to any of the three contracts analyzed in Chapter IV. The authors used the disbursement schedule of contract three in Chapter IV to build a hypothetical contract opportunity for a prospective contractor. Of the three sets of contract data available, this contract, though unprofitable, was chosen because the ship had been delivered, and the contract was nearing completion. For purposes of analysis, the contract price was increased to \$26 million, giving a prospective contractor a profit opportunity of about nine and one-half percent on cost.

The ACM-3 program is capable of producing precise results, but it is anticipated that, in actual practice, the input data will be a series of approximations. The results produced are to be considered only a rough estimate of the time-adjusted rate of return which this cash flow produces. Fortunately, pinpoint accuracy is not required to make this rate of return a valuable measure of the "true" profitability of the contract. Even the rough estimate which these projections provide places the financial analysis of the contract terms in the same frame of reference that the

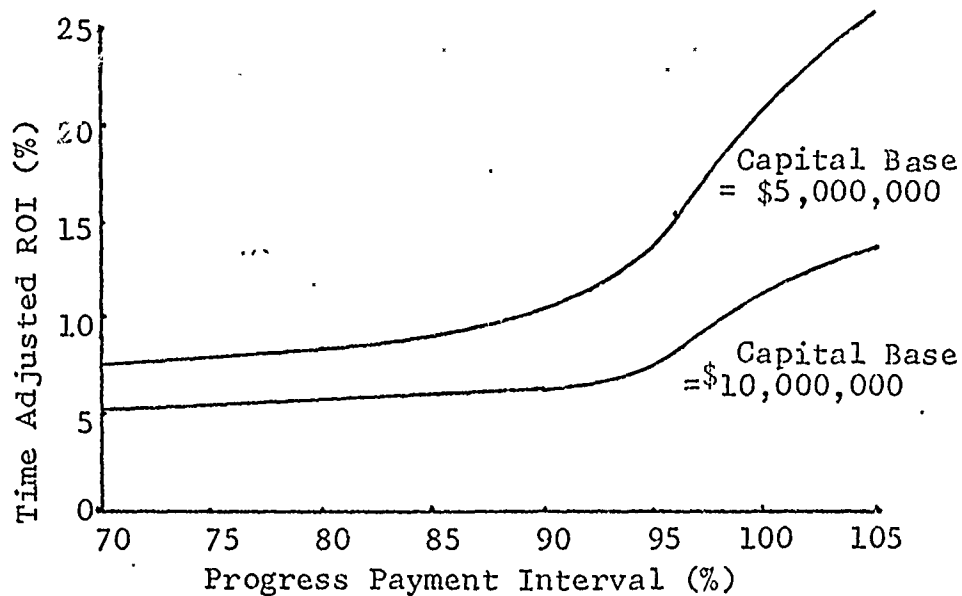
* Harold Bierman, Jr., and Seymour Schmidt, The Capital Budgeting Discussion, The MacMillan Co., New York, 1966, p. 106.

sophisticated contractor employs in his decision process. It allows the government to see the contract as the contractor sees it. Naturally, if the rewards promised by the contract under analysis are not commensurate with other opportunities available to the contractor, a revision of the contract terms would be advisable. The employment of this model in practice is discussed later in this chapter.

The capital base may be the most difficult parameter to gauge accurately. In effect, the model operates on the assumption that the contractor essentially devotes a portion of his physical plant to the accomplishment of the contract under consideration. Because the builder has agreed to allow this equipment to be used on a government contract, it will not be available for alternative uses. The profit that these alternative uses would offer the contractor is the opportunity cost of accepting the government contract.

The proposed ASPR revisions which reflect the inclusions of Profit on Capital contain a worksheet on which the contractor states the amount of capital that he intends to allocate to a specific contract. Although the allocation may be distorted by some companies, it does provide one measure of investment. ASPR E-214 currently provides the Government with the authority to request detailed information as to the contractor's cash flow projections. Since most large contractors prepare this data for their own analysis, it is reasonably attainable.

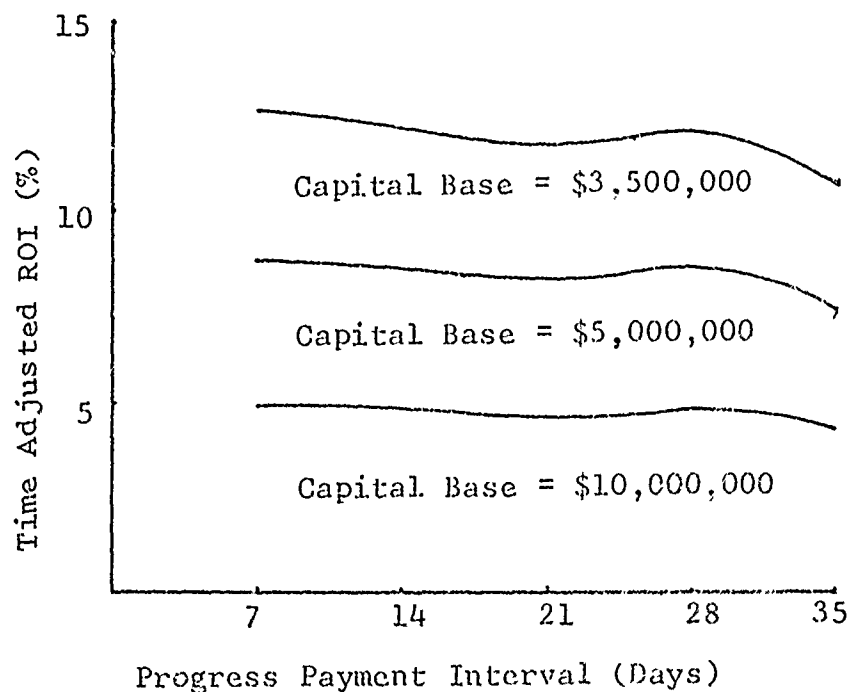
The time adjusted ROI is, of course, particularly sensitive to changes in the capital base. For example, if the capital base on the contract described above, is doubled from an average capital base of five million dollars to ten million dollars and the payment rate and interval are 80% and 14 days, the time adjusted rate of return will decrease from 8.5% to 4.9%. The change in time adjusted ROI as a function of progress payments rate can be observed in Figure 17. The payment interval is held constant at 14 days and the payment rate is varied from 70% to 105%.



Effect of Capital Base and Progress Payment Rate
on Time Adjusted Rate of Return (%)
(Interval Constant at 14 Days)

Figure 17.

The curves of this graph relate the contractor's desire to increase his time adjusted rate of return to the Government's objective to keep the contractor at a positive level of investment. The curve for the Capital Base of \$3 million shows that variations in the progress payment rate chosen cause time adjusted ROI on the contract to range from ten percent to almost 40%.



Effect of Capital Base and Payment Interval
on Time-Adjusted ROI (%)
(Payment Rate Constant at 80%)

Figure 18.

Increasing the profit allowed, or decreasing the capital or work-in-process investment would raise the time

adjusted ROI for the contractor. As shown in Figure 18, the time adjusted ROI is not very sensitive to changes in the payment interval within reasonable bounds (i.e., seven to twenty-eight days). If the Government is to cause the contractor's work-in-process investment to be positive, there are specific limits within which the process payment rate may be negotiated. Output from the ACM-2 programs shows that the contractor's work-in-process investment becomes negative at a rate of 87% and an interval of 14 days. For the \$26 million dollar contract analyzed the 80% rate, 14-day interval generally meets the government goal of a small but positive contractor investment in work-in-process. However, consider a contract of three billion dollars magnitude and contract life of up to eight years. Is it reasonable to cause a contractor to finance an average two percent, \$60 million, from the banking industry? If the reader judges that the cost of such financing to be contrary to the best interests of the Government, then a progress payment rate of 80% is too low. It is suggested that permitting the rate to extend as high as 86% for very large contracts might avoid this extreme financing burden.

Given that the work-in-process investment must be kept positive and that the capital base is fixed, the Government can raise the time adjusted ROI by raising the dollars of profit. The value of ACM-3 to the practitioner is that it provides a vehicle for quick analysis of the effect

of any change in contract terms on the overall profitability of the contract. This gives the contract negotiator information that heretofore was only available by intuition reasoning.

In summary, there are bounds to which the progress payment rate may be set, and a rate of 80% may cause an unreasonably high work-in-process investment. The time adjusted rate of return may not be sensitive to payment interval but does react dramatically to changes in the capital base. Lastly, the profit in dollars may be the one recourse open to enable the government to encourage bidders in the constrained market place of the shipbuilding industry.

B. PROPOSED DECISION POINT APPROACH TO CONTRACT PROFIT ANALYSIS

The procedure below is a decision process which integrates the following elements of a government shipbuilding contract:

1. Contract Profit computed in accordance with the proposed ASPR revisions to reflect investment.
2. Progress payments computed in accordance with the Navy Task Group procedure.
3. The time adjusted rate of return which is implied by contract terms.

a. Decision Point One (DPl)

The purpose of the first decision is to compute the contract profit objective using the proposed ASPR revision. The outputs of this step are, first, dollar amount of profit, and secondly, the profit/contract cost ratio.

The required inputs and procedures will be spelled out when the revised regulations are enacted.

b. Decision Point Two (DP2)

The question to be asked in DP2 is what level of investment must the contractor maintain in work-in-process to insure that he remain motivated to meet schedule and milestone objectives. To answer this question it is important to consider the following facets of the contract:

- (1) What is the projected contract cost?
- (2) What level of technological risk is represented?
- (3) What level of financing risk is present?
- (4) What is the financial condition of the contractor?
- (5) How well has the contractor met the objectives of previous contracts?

These factors are weighted to arrive at a level of investment which is large enough to keep pressure on the contractor, yet not so large as to present a difficult financing burden.

c. Decision Point Three (DP3)

The purpose of this step is to ascertain which combinations of progress payment rate and interval will yield the level of investment in work-in-process the government desires the contractor to maintain. Using a series of algorithms based on the Navy Task Group procedures computer program ACM2

will produce all the combinations which meet this work-in-process criterion. The inputs to ACM2 are as follows:

- (1) Contract Cost
- (2) Contract Profit
- (3) Contractor schedule of disbursements
- (4) Delivery schedule for contracted items
- (5) Desired contractor investment in work-in-

process.

If the disbursements are forecasted on monthly intervals or longer it is recommended that a daily average be used. ASPR E-214 provides the authority for requesting forecasts of this nature from the contractor.

The output of this program will be essentially a series of points which represent indifference points with regard to the resulting average investment. Intervals in weekly increments are more likely to be convenient payment periods. The choice between the workable alternatives could be a negotiation point for the government. The program will provide all the combinations of progress payment rate and progress payment interval of interest to the negotiator to obtain the desired level of contractor investment.

d. Decision Point Four (DP4)

The purpose of Decision Point Four is to place the contract data into the framework of a discounted cash flow analysis.

ACM3, the computer program used at DP4, analyzes the amount of profit, and the method of payment which the

government is proposing. It compares these with the investment which the contractor is committing and the disbursements he will have to make. It then computes the time adjusted rate of return which is implicit in this transaction. ACM3 requires the same input data as Decision Point Three above plus the following information:

(1) The progress payment rate and interval chosen at DP3.

(2) The capital investment schedule mentioned in DP1.

e. Decision Point Five (DP5)

The purpose of Decision Point Five is to compare the time adjusted rate of return arrived at in DP4 with the returns available to the contractor from other sources. If the rate implied by the governments terms is significantly lower than the rate available elsewhere the contractor will be compelled to refuse the contract. If the government rates are higher than those prevailing from other sources, a reduction in the amount of profit should be considered.

Inputs are:

(1) The time adjusted rate of return implied in the contract.

(2) The rate of return prevailing in the market.

The only output of DP5 is a subjective judgment as to the profit adequacy. If the profit is adequate, the process is complete. If it is inadequate or excessive the analyst returns to DP1 and alters the initial decisions as necessary.

TABLE XII.

DPI

CONTRACT PROFIT OBJECTIVE

Tool: Revised Weighted Guidelines with Profit on Capital

Inputs: 1. Contract Cost Data
2. Contract Risk Data
3. Contractor Capital Data

Outputs: 1. Profit/Cost Ratio
2. Contract Profit in Dollars

DP2

DESIRED CONTRACTOR INVESTMENT IN WORK IN PROCESS

Tool: Judgment

Inputs: 1. Contract Cost
2. Contract Technological Risk
3. Contract Financial Risk
4. Contractor Financial Condition
5. Contractor Performance History

Outputs: 1. Desired Contractor Investment in Work in Process

DP3

PROGRESS PAYMENT POSSIBILITIES CURVES

Tool: ACM2

Inputs: 1. Contract Cost
2. Contract Profit in Dollars
3. Contractors Schedule of Disbursements
4. Delivery Schedule for Contracted End Items
5. Contract Completion Date
6. Desired Contractor Investment in Work in Process

Outputs: 1. Possible combinations of progress payments rate and interval which meet the desired investment in work in process

TABLE XII. (Continued)

DP4

CALCULATION OF TIME ADJUSTED RATE OF RETURN IMPLIED BY THE
CONTRACT TERMS

Tool: ACM3

Inputs: 1. Contract Cost
2. Contract Profit in Dollars
3. Contractors Schedule of Disbursements
4. Delivery Schedule of Contracted End Items
5. Contract Completion Date
6. Progress Payment Rate and Interval Selection
7. Contractor Schedule of Investments

Outputs: 1. Time adjusted Rate of Return Implied by the
Contract Terms
2. Schedule of Government Payments

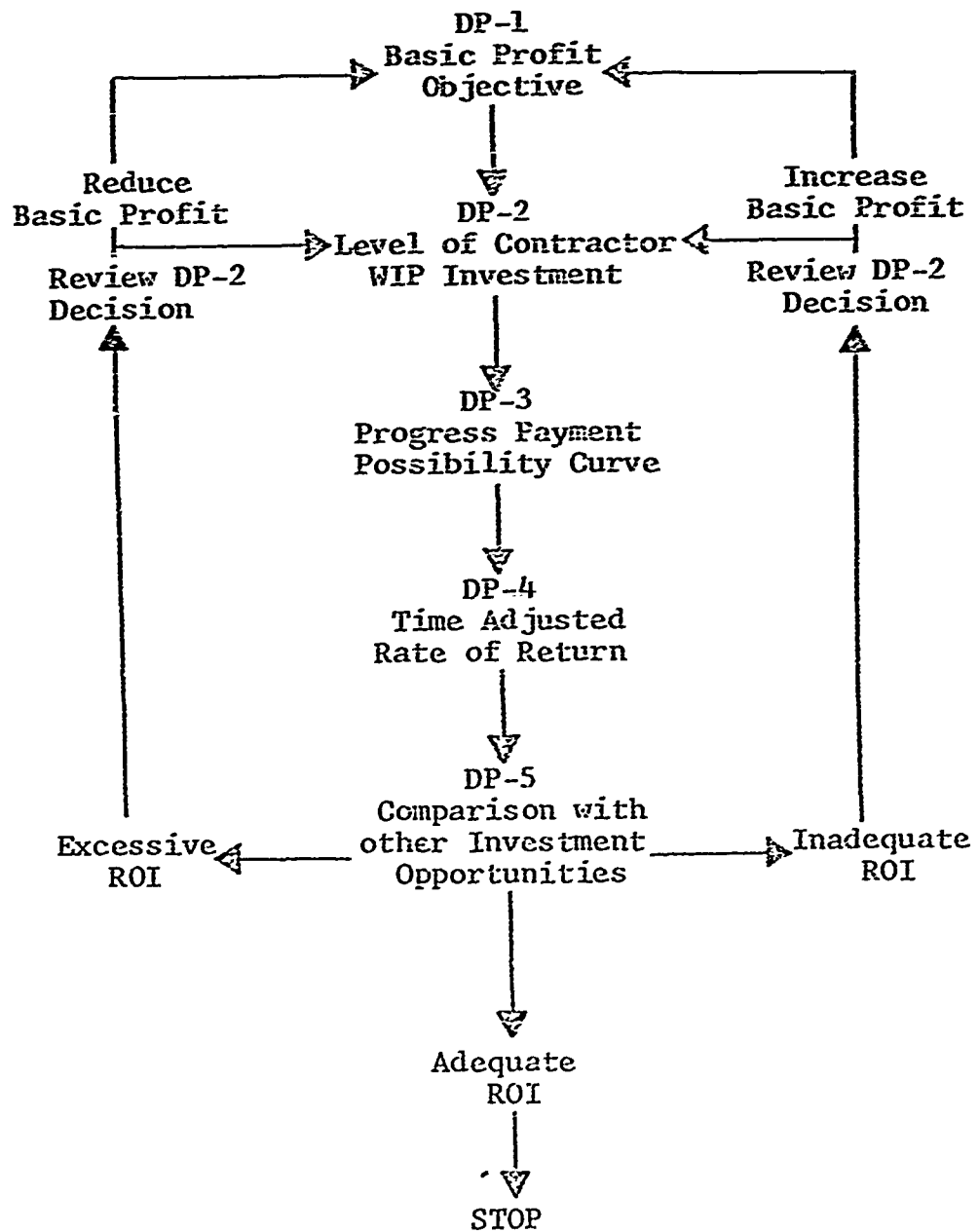
DP5

ADEQUACY OF COMPENSATION (PROFIT)

Tool: Judgment

Inputs: 1. Time Adjusted Rate of Return Implied in the
Contract
2. Rate of Return on the Contractor's Alternative
Investment

Outputs: 1. Decision as to adequacy of the Profit Offered
the Contractor



PROFIT NEGOTIATION DECISION MODEL

CHAPTER VI.

CONCLUSIONS AND RECOMMENDATIONS

The profit on capital approach set forth by the IAC Subcommittee represents a major improvement in the profit policy of the Department of Defense and it has great potential for improving the performance of defense contractors. Similarly, the recommendations of the Navy Task Group could largely eliminate the abuses and failings of previous contractor financing arrangements. It is noted, however, that in the recommendations, both bodies settled upon fixed figures and percentages which may unduly restrict the negotiating range of contracting officers. It is the conclusion of this thesis that the rigidities inherent in both of these studies may tend to work against the best interest of the government. Three specific recommendations of the IAC Subcommittee are possibly self-defeating:

1. The recommendation of standard profit based on durable goods - Market conditions prevailing in all sectors of the defense economy are unlikely to be commensurate with any single measure from civilian industry. Although it is clearly necessary for the defense contractor to earn comparable profit, only those firms which lack serious competition will benefit from this policy. The establishment of an artificial profit standard which does not account for opportunity cost of the shipbuilding resources is likely to

improve the profit record of few shipbuilders.

2. Equal weightings on Cost and Capital - The establishment of a standard 50/50 weighting system implied the existence of an optimum allocation of capital and labor to government contracts. This system may provide an inappropriate incentive to substitute capital for labor. Ideally the weights should be applied in accordance with some optimum allocation efficiency for the industry involved, as there is no evidence to suggest the labor/capital ratio should be the same for all industries. The problem of determining the "best mix" is not currently resolved (and is recommended as an area for further study).

3. Establishment of a progress payment policy based upon 80%, 14 day standard.

The analysis in Chapter V. has shown that the adherence to this standard provides an obstacle to what should be the government's primary concern, that is, insuring that the contractor has a slight positive investment in the work in process. A more flexible regulation which allows deviation from the 80% rate necessary to meet the investment objectives is recommended.

The use of the decision point process outlined in Chapter V. provides a means of coordinating the profit policy with the progress payment policy. Furthermore, it allows the contracting officer to compare the profitability of the government position with the returns available in the commercial market place. It provides simultaneous consideration of the contractor's discounted cash flow.

APPENDIX A: LIQUIDATION*

Liquidation. Progress payments viewed as a loan must be repaid, i.e., liquidated. Liquidation of progress payments outstanding is accomplished by deducting a portion of the billing price due the contractor when he delivers an end item. When this occurs, the amount deducted is credited to the contractor's outstanding progress payments account.

Ordinary Liquidation - One method of liquidation is to recover an amount from each delivery billing equal to the percentage of progress payment. For example, a rate of 80% progress payments requires 80% deduction from each delivery billing. This method of liquidation is called ordinary liquidation, and it pays a contractor only a nominal portion of estimated profit in each delivery payment.

Alternate Liquidation - A second method for liquidation of progress payments, called alternate liquidation, is very often used for contracts with negotiated profit rates. Under this method, the minimum liquidation would be computed by multiplying total cost by the percentage of progress payment and dividing the product by the contract price. For example, if price is \$110 and costs are \$100 the minimum liquidation percentage under an 80% progress payment would be:

$$\frac{100 \times 80}{110} = 72.72\%$$

Thus 72.72% of each delivery billing would be used to liquidate the progress payments. Unlike the first method, billing price in this case includes a portion of the contractor's estimated profit at completion of the contract.

* Department of Defense, Report of the Industry Advisory Council Subcommittee to Consider Defense Industry Contract Financing, June 11, 1971.

APPENDIX B.

Navy Task Group Recommended Alternate Method for Shipbuilding Progress Payments*

However, the Task Group believes that a payment system based essentially on a cost-incurred system used by the Defense Department for supply type contracts, with certain additions and adaptations for the peculiarities of the shipbuilding industry would be feasible. Because shipbuilding contracts extend over a rather protracted period of time before any deliveries are made, in contrast to the normal supply type contract, the Task Group inquired as to whether some milestones could be established for interim payments. It was generally concluded that there are no universal milestones which can be readily adopted. Accordingly, it was concluded that percentages of completion might well serve as such milestones. The Task Group has attempted to adapt the standard defense contract progress payments clause as prescribed in Appendix E, Part 5, of ASPR, to shipbuilding progress payments with some variations to accommodate the differences between shipbuilders and other suppliers and proposes the following payment provisions for shipbuilding, and ship construction and repair contracts.

* Department of the Navy, Report of the Task Group to Study Shipbuilding Progress Payments, March 1972.

Progress payments under the proposal will be made in accordance with the progress payment provisions for supply type contracts as set forth in Part 5 of Appendix E to ASPR. An additional clause would be included in contracts for ship construction, conversion, alteration or repair to read substantially, as follows: Additional "interim" payments will be made as provided hereinafter. When the progress payments paid hereunder are equal to the percentage of the contract price shown in Column A, an interim payment will be made. Such interim payments will be an amount equal to the percentage of the contract price shown in Column B¹, less the amount of total payments theretofore made, provided that the physical percentage of completion, as determined by the SUPSHIP, is equal to a percentage of completion not less than the percentage shown in Column C; however, if the physical completion, as determined by the SUPSHIP, is less than the percentage in Column C, such interim payments will not be made until physical completion reaches the percentage shown in Column C. The following schedule is applicable to contracts which provide for 80% progress payments:

¹ This percentage represents 98% of the percentage of completion determined by the dollar progress. On 80% progress payments based on costs, 12.5% of the contract would be reached when progress payments are equal to 10% of the contract price. (12.5% x 80% = 10.0%)

<u>Interim Payment Number</u>	<u>Column A</u>	<u>Column B</u>	<u>Column C</u>
1	10%	12.25%	10.0%
2	20	24.50	22.0
3	30	36.75	34.0
4	40	49.00	46.0
5	50	61.25	58.0
6	60	73.50	70.0
7	70	85.75	82.5

For small business contractors where progress payments are based on 85% the following schedule is applicable:

<u>Interim Payment Number</u>	<u>Column A</u>	<u>Column B</u>	<u>Column C</u>
1	10.625%	12.25%	10.0%
2	21.250	24.50	22.0
3	31.875	36.75	34.0
4	42.500	49.00	46.0
5	53.125	61.25	58.0
6	63.750	73.50	70.0
7	74.375	85.75	82.5

If the period of time from the signing of the contract to delivery of the first vessel is less than three years, only the interim payments Nos. 2, 4, and 6 will be made; if more than three but less than four years, only 1, 2, 4, 5, and 7 will be made; if more than four years, interim payments 1 through 7 will be made.

The difference between the indicated percentage of completion and the amounts paid, including the interim payments, as indicated below, shall be held as a performance reserve for the purpose of meeting the cost of finishing unfinished work or of correcting defects.

When Progress Payments Reach		Indicated Percentage of Completion of Payments to Contract Is Be Made Are Reserve Is		
80% prog payt	85% prog payt			
10	10.625	12.5	12.25	.25
20	21.250	25.0	24.50	.50
30	31.875	37.5	36.75	.75
40	42.500	50.0	49.00	1.00
50	53.125	62.5	61.25	1.25
60	63.750	75.0	73.50	1.50
70	74.375	87.5	85.75	1.75
80	85.000	100.0	98.00	2.00

All contracts will be required to specify a contract price for each vessel. If the contract requires the contractor to provide or furnish material, drawings, designs, specifications, computer software or other items, such items may be set forth as a separately priced line item in the contract or these items may be included as a part of the price of the vessels. Progress payments will be liquidated upon delivery of each vessel or delivery of any separately priced line item. However, in view of the "interim" payments provided for by the recommended system, the alternate method of liquidation provided for by paragraph E-512.2 will not be applicable to shipbuilding contracts.

Upon preliminary acceptance of each vessel the Government will pay the following percentages of the contract price of the vessel:

If interim payments are made for following number of payments	If progress payment rate is	
	80%	85%
1 thru 7	2.25%	1.625%
2, 4, 6	4.50%	3.25 %
1, 2, 4, 5, 7	2.25%	1.625%

Upon expiration of the guaranty period, the Government will pay the contractor an amount equal to 2% of the contract price, less whatever amount the Contracting Officer determines is an amount sufficient to cover any defects or deficiencies which have not yet been corrected by the contractor. Upon preliminary acceptance of the vessel the Government will liquidate progress payments equal to 80% or 85% of the contract price, whichever percentage is used for making progress payments of the contract price of each vessel.

Upon final acceptance of any separately-priced line item other than a vessel, the Government will pay the contractor the percentage shown in TABLE A below of the contract value of the line item and will liquidate progress payments of 80% or 85% of the contract price of the line item, whichever percentage is used for making progress payments.

TABLE A

<u>If interim payments are made for the following number of payments</u>	<u>If progress payment rate is</u>	
	<u>80%</u>	<u>85%</u>
1 thru 7	4.25%	3.625
2, 4, 6	6.50	5.25
1, 2, 4, 5, 7	4.25	3.625

The Government shall, at the time of final settlement in accordance with the provisions of the clause entitled "Final Settlement", pay the Contractor the balance owing to it under the contract promptly after the amount of such balance shall have been determined.

Sub-contractor progress payments will be made in accordance with Appendix E to ASPR, except that they will provide for the same variations set forth above.

Percentage of Completion under Alternate Method

The Task Group recognizes that even though it has criticized the accuracy of the system of progress payments based on a percentage of completion, the payment provisions recommended require that a determination shall be made of physical progress and if the indicated lag exists between dollar progress and physical progress, the interim payments shall be delayed. An examination of the provision will readily reveal that the Task Group has allowed for a percentage of lag -- a variation in judgment factor, so to speak, -- between the indicated physical percentage of completion and the dollar progress.

Relative to this requirement for determination of physical progress, the Task Group would like to point out that representatives of the Ship Systems Command and representatives of certain shipbuilding contractors have indicated that even though a method of making progress payments were to be adopted other than the percentage of completion method, it would be necessary to continue to have a measure of percentage of completion. The Ship Systems Command would need this information in order to be kept advised as to when vessels could be expected to be ready to be added to the fleet and for other planning purposes.

The provisions as prescribed in Appendix E to ASPR for progress payments based on incurred or paid costs contain restrictions which provide that the Contracting Officer will suspend or reduce progress payments whenever the Contracting Officer determines based upon "substantial evidence" that the contractor "has so failed to make progress that the unliquidated progress payments exceed the fair value of the work accomplished on the undelivered portion of the contract.

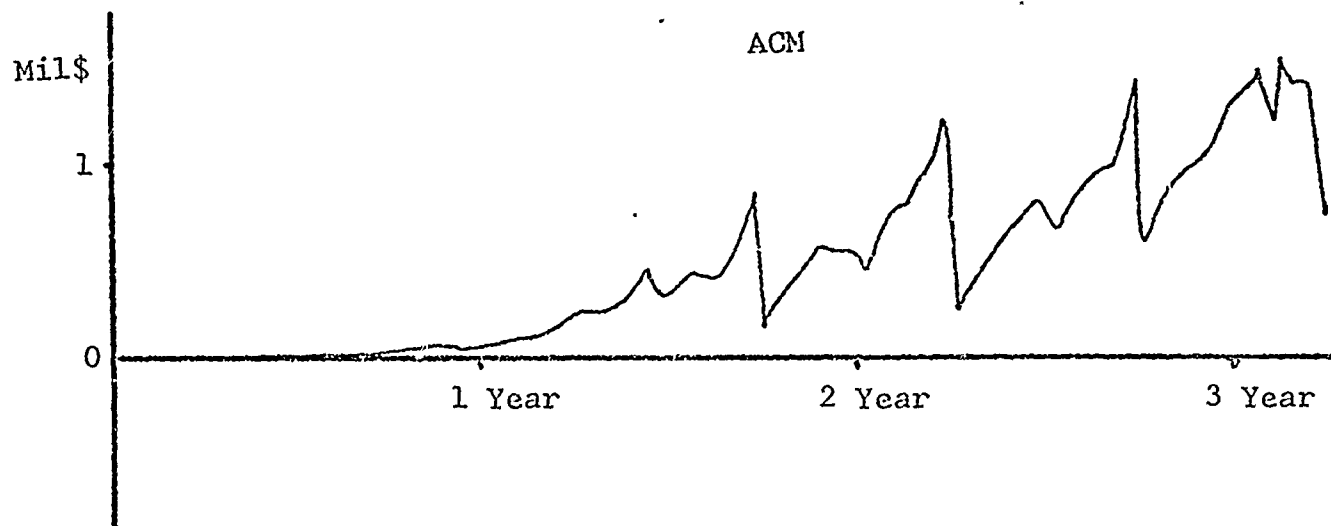
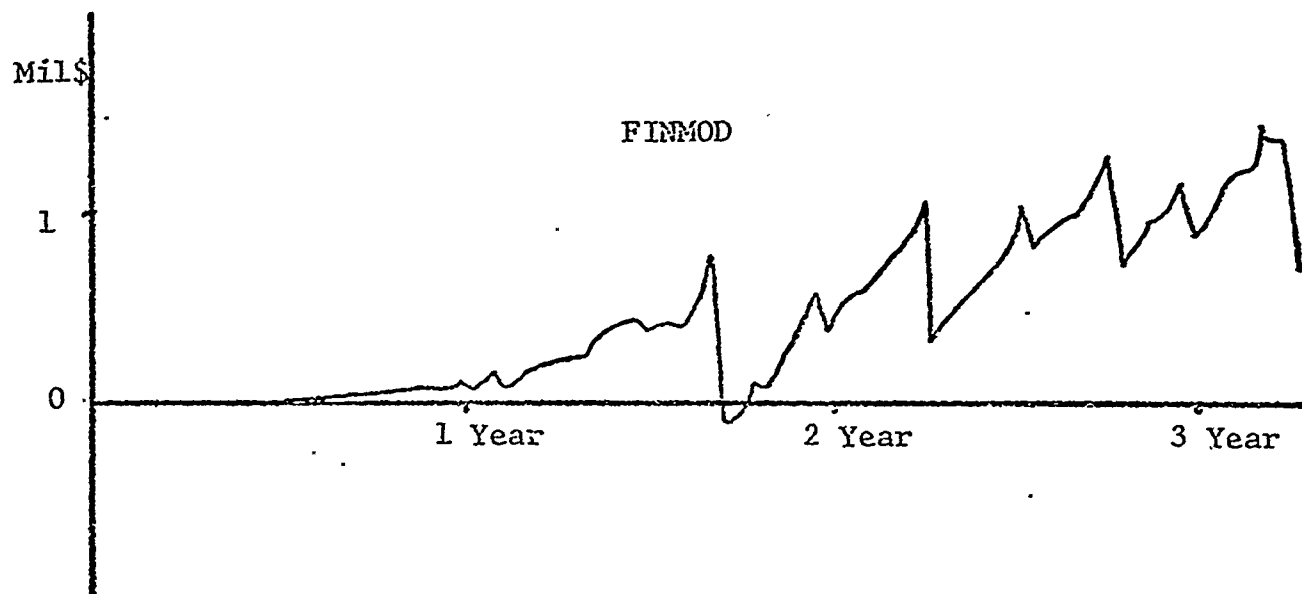
APPENDIX C

DISCUSSION OF ACM-1 OUTPUTS

The only purpose of the ACM programs and model is to provide a convenient tool for analysis of contract terms before the contract is awarded. They are not intended to analyze ongoing or completed contracts. However, to insure that the ACM model provided accurate portrayal of the payment method proposed in the report of the Navy Task Group, a comparison was conducted with the results produced by the Air Force Contract Financing Model for three ongoing contracts. Since the data used in the FINMOD intends to analyze the effect of lags, the inputs to the ACM model were not identical and consequently the occurrence of payments was expected to vary from the FINMOD. The results displayed below show that the models produce results which, considering the different input data and detail of analysis, are basically similar. The comparison is made for a progress payment rate of 80% and a payment interval of 14 days.

TABLE XIV.

<u>CONTRACT 3</u>	<u>FINMOD</u>		<u>ACM</u>	
	<u>Day</u>	<u>Amount (K\$)</u>	<u>Day</u>	<u>Amount (K\$)</u>
Average WIP contractor invest.	-		-	582
Highest WIP contractor invest.	-	1891		1959
Lowest WIP contractor invest.	-	-246		-12
Interim Payment amount #1	651	1197	653	842
" " " #2	861	856	849	1213
" " " #3	1057	1098	1045	728
Final Payment	1225	783	1226	1049



Average Daily Contractor Investment - Contract Three

Figure 19.

Comparative results for the second contract with a progress payment rate of 80% and interval of 14 days is as follows:

<u>CONTRACT 2</u>	<u>FINMOD</u>		<u>ACM</u>	
	<u>Day</u>	<u>Amount(K\$)</u>	<u>Day</u>	<u>Amount (K\$)</u>
Average WIP Contractor Investment	-	1050	-	1728
Highest WIP Contractor Investment	-	6557	-	6919
Lowest WIP Contractor Investment	-	-3264	-	-909
Interim Payment Amount #1	504	2558	492	2252
" " " #2	644	3377	646	2238
" " " #3	784	1824	786	2534
" " " #4	938	3299	926	3069
" " " #5	1078	2867	1066	2495
" " " #6	Not yet paid			

Comparable results for Contract one are unavailable.

LAG IS THE TIME LAG BETWEEN THE LAST DAY OF DISBURSEMENT DATA THAT THE

[illegible]

CONTRACTOR SUBMITS TO THE GOVERNMENT AND THE DAY WHEN THE PROGRESS PAY-
MENT IS MADE.

IYEAR IS A COUNTER FOR THE NUMBER OF YEARS IN THE CONTRACT.

FINFAC IS THE FINANCING ADJUSTMENT USED TO CAUSE THE DISBURSEMENT DATA
TO REFLECT ASPR REQUIREMENTS.

MDAY IS THE LAST DAY TO BE CONSIDERED FOR THE ANALYSIS OF THE CONTRACT.

ISHIP IS THE NUMBER OF UNITS OR SHIPS TO BE DELIVERED IN THIS CONTRACT.

NINT IS THE NUMBER OF INTERIM PAYMENTS TO BE PAID WHICH IS DETERMINED
BY THE CONTRACT LIFE IN YEARS.

IPIROG IS THE PROGRESS PAYMENT INTERVAL IN DAYS.

READ(5,10001)RPROG,RPRLIM,ILAG,IYEAR,FINFAC,MDAY,ISHIP,NINT,IPIROG

INFORMATION FOR ARRAYS DEFINED IN DIMENSION STATEMENT ARE READ IN HERE.

READ(5,10003) (RINTRM(I), I=1,NINT)
READ(5,10002) (PERCNT(I), I=1,NINT)
READ(5,10007) (UPRICE(I), I=1,ISHIP)
READ(5,10005) (IDELV(I), I=1,ISHIP)
READ(5,10007) (EPRICE(I), I=1,IYEAR)
DO 501 I=1,1250
DO 502 J=1,8
PAYMT(I,J)=0000000.0
WRITE(6,20001)
ICAY=0

50

THE ARRAY PAYMT(MDAY,8) IS BUILT HERE WITH EACH CUMULATIVE MONTHLY AMOUNT
OF DISBURSEMENTS ENTERED SEQUENTIALLY THROUGH THE LIFE OF THE CONTRACT.

IDAY = 1
PFLOAT = 0.0
PREDSB = 0.0
JDAY = 1
READ(5,10006) DISB,FLOAT
ADISB = DISB - PREDSB
BDISB = ADISB/30.417
AFLOAT = FLOAT*DISB/100.0
BFLOAT = AFLOAT - PFLOAT
PFLOAT = AFLOAT

100

CCCCCCCCCCCCCCCCCCCCCCCCCCCC

CCCCC


```

110 PREDSB = DISB
    IF (IDAY.GT.MDAY) GO TO 200
    PAYMT (IDAY,1) = IDAY
    PAYMT (IDAY,2) = @DISB
    PAYMT (IDAY,6) = BFLOAT
    ICAY = ICAY + 1
    JDAY = JDAY + 1
    IF (JDAY.GT.30) GO TO 100
    GO TO 110

```

C

```

200 BOTTOM = 0.0
    CDISB=0.0
    CHECK=0.0
    CINTRM=0.0
    CPRDGM=0.0
    IDAY=0
    IDISB=0
    IEDAY = 0
    INTRM=1
    IPAY=1
    IPADAY=0
    JYEAR=1
    IDISB=0.0
    TOP = 0.0
    PRICE = EPRICE(JYEAR)
    DO 60 J = 1,1250
    DO 60 J = 3,5
    PAYMT(I,J) = 0.0
    DO 70 I = 1,1250
    DO 70 J = 7,8
    PAYMT (I,J) = 0.0

```

60

70

C

CALCULATE DISBURSEMENTS AND BRANCH TO VARIOUS PAYMENT ROUTINES.

```

210 IDAY=IDAY+1
    IEDAY = IEDAY + 1
    IDISB=IDISB+1
    IDISB=IDISB+PAYMT (IDAY,2)
    CDISB=CDISB+PAYMT (IDAY,2)
    PAYMT (IDAY,1)=IDAY
    IF (IDELV(IPAY).EQ. IDAY) GO TO 500
    IF (IDISB.EQ.IPRG) GO TO 300
    IF (INTRM.GT.NINT) GO TO 240
    IF (CHECK.GE.PERCNT(INTRM)) GO TO 400
    IF (IDAY.EQ.MDAY) GO TO 620

```

220

230

240

GO TO 210

CCCC

CALCULATE PROGRESS PAYMENTS.

300 RPRGGG = RPRGGG - FINFAC

PRGG = RPRGGG * TDISB

IPADAY = IDAY + ILAG

CPRGG = CPRGG + PRGG

... PAYMT(IIPADAY,3) = PRGG GO TO 320

IF (IEDAY.GT.365) GO TO 320

310 CHECK = 0.0

TDISB = 0

IDISB = 0

GO TO 230

IF (JYEAR.EQ.1 YEAR) GO TO 310

JYEAR = JYEAR + 1

PRICE = EPRICE(JYEAR)

IEDAY = 0

GO TO 310

CCCC

CALCULATE INTERIM PAYMENTS.

400 IF (CHECK.GE.0.8) GO TO 240

ZINTRM = RINTRM * (INTRM) * PRICE

YINTRM = ZINTRM - CPRGG - CINTRM - CPRELM

PAYMT(IIPADAY,4) = YINTRM

CINTRM = CINTRM + YINTRM

INTRM = INTRM + 1

GO TO 240

CCCC

CALCULATE INTERIM PAYMENTS FOR PRELIMINARY ACCEPTANCE OF MAJOR END ITEMS.

500 PRELM = RPRELM * UPRICE(IIPAY)

CPRELM = CPRELM + PRELM

PAYMT(IICAY,5) = PRELM

IF (IIPAY.EQ.1SHIP) GO TO 220

IIPAY = IIPAY + 1

GO TO 220

CCCC

CALCULATE THE CONTRACTOR'S WORK-IN-PROCESS INVESTMENT.

620 ICAY = 1

CINVEST = 0.0

IINVEST = 0.0

```

630  RECV = PAYMT(IDAY,3)+PAYMT(IDAY,4)+PAYMT(IDAY,5)+PAYMT(IDAY,6)
    PAYMT(IDAY,7) = PAYMT(IDAY,2) - RECV
    CINVST = CINVST + PAYMT(IDAY,7)
    IF (TOP.LT.CINVST) GO TO 650
    IF (BOTTOM.GT.CINVST) GO TO 670
640  PAYMT(IDAY,8) = CINVST
    IF (IDAY.EQ.MDAY) GO TO 700
    ICAY = ICAY + 1
    GO TO 630
650  TOP = CINVST
    GO TO 640
670  BOTTOM = CINVST
    GO TO 640
C 700  A/GINV = TINVST/MDAY
    WRITE (6,20002) RPROG,IPROG,AVGINV,TOP,BOTTOM
    WRITE (7,30002) IPROG,RPROG,AVGINV,BOTTOM,TOP
    IF (RPROG.GT.1.10.AND. IPROG.GT.59) GO TO 800
    IF (IPROG.GT.59) GO TO 720
    IPRG = IPRG + 1
    GO TO 200
720  IPRG = 7
    RPROG = RPROG + 0.01
    GO TO 200
C 800  WRITE (6,10001) RPROG,RPRLIM,ILAG,IYEAR,FINFAC,MDAY,ISHIP,NINT,IPROG
    WRITE (6,10003) (RINTRM(I), I=1,NINT)
    WRITE (6,10002) (PERCNT(I), I=1,NINT)
    WRITE (6,10007) (UPRICE(I), I=1,ISHIP)
    WRITE (6,10005) (IDELV(I), I=1,ISHIP)
    WRITE (6,10007) (EPRICE(I), I=1,IYEAR)
    FORMAT (2X,2F5.4,I5,I11,F9.5,I10,3I5)
10001  FORMAT (2X,7F10.4)
10002  FORMAT (2X,7F10.5)
10003  FORMAT (2X,7I10)
10005  FORMAT (2X,F10.0,9X,F4.1)
10006  FORMAT (2X,7F11.0)
10007  FORMAT (5X,PROG,PAYMT RATE - %,5X,PAYMT INTERVAL - DAYS,5X,AV
20001  IG INVESTMENT - $,5X,HIGHEST INVESTMENT - $,5X,LOWEST INVESTMEN
    IT - $,/)
20002  FORMAT (F18.2,I24,F28.2,F23.2,F25.2)
30002  FORMAT (5X,I5,4F14.2)
    STOP
    END

```

RRPROG IS THE PERCENT OF DESBURSEMENT ON WHICH PROGRESS PAYMENTS ARE MADE. IT IS NOT USED IN ALL RUNS OF THIS PROGRAM.

[illegible]

```

CCCCCCCCCCCCCCCC CCCCCCCCCC CCCCCC
RPR LIM IS THE PERCENT OF EACH UNIT PRICE (SHIP'S PRICE) PAID ON
PRILIMINARY ACCEPTANCE OF THE END ITEM.
ILAG IS THE TIME LAG BETWEEN THE LAST DAY OF DISBURSEMENT DATA THAT THE
CONTRACTOR SUBMITS TO THE GOVERNMENT AND THE DAY WHEN THE PROGRESS PAY-
MENT IS MADE.
IYEAR IS A COUNTER FOR THE NUMBER OF YEARS IN THE CONTRACT.
FINFAC IS THE FINANCING ADJUSTMENT USED TO CAUSE THE DISBURSEMENT DATA
TO REFLECT ASPR REQUIREMENTS.
MDAY IS THE LAST DAY TO BE CONSIDERED FOR THE ANALYSIS OF THE CONTRACT.
ISHIP IS THE NUMBER OF UNITS OR SHIPS TO BE DELIVERED IN THIS CONTRACT.
NINT IS THE NUMBER OF INTERIM PAYMENTS TO BE PAID WHICH IS DETERMINED
BY THE CONTRACT LIFE IN YEARS.
IPROG IS THE PROGRESS PAYMENT INTERVAL IN DAYS.

READ(5,10001)RPROG,RPRLIM,ILAG,IYEAR,FINFAC,MDAY,ISHIP,NINT,IPROG

INFORMATION FOR ARRAYS DEFINED IN DIMENSION STATEMENT ARE READ IN HERE.

READ(5,10003) {RINTRM(I), I=1,NINT}
READ(5,10002) {PERCNT(I), I=1,NINT}
READ(5,10007) {UPRICE(I), I=1,ISHIP}
READ(5,10005) {IDELV(I), I=1,ISHIP}
READ(5,10007) {EPRICE(I), I=1,IYEAR}
READ(5,10004) CAP1,CAP2
DO 50 I=1,1250
CC 50 J=1,8
PAYMT(I,J)=0000000.0
IDAY=0
RATE = 0.0001

50

THE ARRAY PAYMT(MDAY,8) IS BUILT HERE WITH EACH CUMULATIVE MONTHLY AMOUNT
OF DISBURSEMENTS ENTERED SEQUENTIALLY THROUGH THE LIFE OF THE CONTRACT.

PFLCAT = 0.0
PREDSB = 0.0
ICAY = 1
100 JDAY = 1
CCCCC

```

```

READ(5,10006) DISB,FLOAT
ADISB = DISB - PREDISB
WRITE (6,10006) DISB,FLOAT
BDISB = ADISB/30.417
AFLOAT = FLOAT*DISB/100.0
BFLOAT = (AFLOAT - PFLOAT)/30.417
PFLOAT = AFLOAT
PREDISB = DISB
110 IF (IDAY.GT.MDAY) GO TO 200
PAYMT(IDAY,1) = IDAY
PAYMT(IDAY,2) = BDISB
PAYMT(IDAY,6) = BFLOAT
IDAY = IDAY + 1
JDAY = JDAY + 1
IF (JDAY.GT.30) GO TO 100
GO TO 110

```

C

```

200 CHECK=0.0
CDISB=0.0
CINTRM=0.0
CPRELM=0.00
CPRQG=0.0
IDAY=0
IDISB=0
IEDAY=0
INTRM=1
IPAY=1
IPADAY=0
JYEAR=1
PKERT=0.0
TDISB=0.0
TEMRT=0.0
VPAYMT=0.0
VRECV=0.0
PRICE = EPRICE(JYEAR)

```

C
C
C

CALCULATE DISBURSEMENTS AND BRANCH TO VARICUS PAYMENT ROUTINES.

```

210 IDAY=IDAY+1
IEDAY = IEDAY + 1
IDISB=IDISB+1
TDISB=IDISB+PAYMT(IDAY,2)
CDISB=CDISB+PAYMT(IDAY,2)
IF (IDELV(IPAY).EQ.IDAY) GO TO 500
IF (IDISB.EQ.IPRQG) GO TO 300
220 IF (INTRM.GT.NINT) GO TO 240
230

```

```

240 IF (CHECK.GE.PERCNT(INTRM)) GO TO 400
    IF (IDAY.EQ.MDAY) GO TO 600
    GO TO 210

```

CCCC

CALCULATE PROGRESS PAYMENTS.

```

300 RPRGG = RPROG - FINFAC
    PRGC = RPROG*IDISB
    IPADAY=IDAY+ILAG
    CPROG=CPROG+PRGC
    PAYMT(IPADAY,3)=PROG
    IF (IDAY.GT.365) GO TO 320
    CHECK = CPROG/PRICE
    IDISB=0.0
    IDISB=0
    GO TO 330
320 IF (JYEAR.EQ.1YEAR) GO TO 310
    JYEAR = JYEAR + 1
    PRICE = EPRICE(JYEAR)
    IDAY = 0
    GO TO 310

```

CCCC

CALCULATE INTERIM PAYMENTS.

```

400 IF (CHECK.GE.0.8) GO TO 240
    ZINTRM=INTRM(INTRM)*PRICE
    YINTRM=ZINTRM-CPROG-CPRELM
    PAYMT(IPADAY,4) = YINTRM
    CINTRM=CINTRM+YINTRM
    INTRM=INTRM+1
    GO TO 240

```

CCCC

CALCULATE INTERIM PAYMENTS FOR PRELIMINARY ACCEPTANCE OF MAJOR END ITEMS.

```

500 PRELIM=RPRLIM*UPRICE(IPAY)
    CPRELM=CPRELM+PRELIM
    PAYMT(IDAY,4) = PAYMT(IDAY,4) + PRELIM
    IF (IPAY.EQ.ISHIP) GO TO 220
    IPAY=IPAY+1
    GO TO 220

```

CCCC

CALCULATE PAYMENT FOR FINAL SETTLEMENT.

```

600 FNPAY = PRICE - CPROG - CINTRM - CPRELM

```

```

        IF (FNPAY.LT.0.0) GO TO 620
        PAYMT(ICAY,5) = FNPAY
        IDAY = IDAY - 1
        PAYMT(1,2) = PAYMT(1,2) + CAP1
        PAYMT(ICAY,5) = CAP2
    
```

620

CCCC

CALCULATE THE CONTRACTOR'S WORK-IN-PROCESS INVESTMENT.

```

        IDAY = 1
        CINVEST = 0.0
        RECV = PAYMT(IDAY,3)+PAYMT(IDAY,4)+PAYMT(IDAY,5)+PAYMT(IDAY,6)
        PAYMT(ICAY,7) = PAYMT(IDAY,2) - RECV
        CINVEST = CINVEST + PAYMT(IDAY,7)
        PAYMT(IDAY,8) = CINVEST
        IF (IDAY.EQ.MDAY) GO TO 650
        IDAY = IDAY + 1
        GO TO 630
    
```

630

CCCC

CALCULATE THE PRESENT VALUE OF THE CONTRACTOR'S DISBURSEMENTS AND RECEIPTS

```

        IDAY = 1
        VPAYMT = 0.0
        VRECV = 0.0
        VRECV = VRECV + RECV*(1+RATE)**(-IDAY)
        VPAYMT = VPAYMT + PAYMT(IDAY,2)*(1+RATE)**(-IDAY)
        IF (IDAY.EQ.MDAY+1) GO TO 700
        ICAY = IDAY + 1
        GO TO 670
    
```

650

670

CCCC

CALCULATE THE NEW INTEREST RATE.

```

        IF (VRECV-VPAYMT).LT.-1.0) GO TO 710
        IF (VRECV-VPAYMT).GT.1.0) GO TO 720
        GO TO 730
        TEMPT=RATE
        REAT = ((1.0+RATE)**365.0) - 1.0
        RATE=RATE-CABS(PRETT-RATE)/2.0
        PRETT=TEMPT
        GO TO 650
        TEMPT=RATE
        REAT = ((1.0+RATE)**365.0) - 1.0
        RATE=RATE+DABS(PRETT-RATE)/2.0
        PRETT=TEMPT
        GO TO 650
    
```

700

710

720


```

730 PROF= (PRICE-CDISB)/CDISB)*100.0
PROFIT = PROF*CDISB/100.0
REAT= ((1.0+RATE)*365.0) - 1.0
XCAY = REAT#100.0
AROI = (100.0*(PRICE-CDISB)/((CAP1+CAP2)/2.0))*365.0/XDAY

C
WRITE (6,20004)
WRITE (6,20008)
WRITE (6,20005)
WRITE (6,20002)
WRITE (6,20009)
WRITE (6,20006)
WRITE (6,20007)
WRITE (6,10001)
WRITE (6,10003)
WRITE (6,10002)
WRITE (6,10007)
WRITE (6,10005)
WRITE (6,10007)
WRITE (6,10004)
WRITE (6,10004)

CDISB, PRICE, PROF, PROFIT, AROI, REAT
CAP1, CDISB, CPROG, CINTRM, CPRELM, FNPAY, CAP2, PRICE
((PAYMT(I,J), J=1,8), I=1,1250)
PRGRM, RPRLM, ILAG, IYEAR, FINFAC, MDAY, ISHIP, NINT, IPROG
((RINTRM(I), I=1,NINT))
((PERCNT(I), I=1,NINT))
((UPRICE(I), I=1,ISHIP))
((IDELV(I), I=1,ISHIP))
((EPRICE(I), I=1,IYEAR))
CAP1, CAP2

10001 FORMAT (2X,2F5.4,15,111,F9.5,110,315)
10002 FORMAT (2X,7F10.4)
10003 FORMAT (2X,7F10.5)
10004 FORMAT (2X,2F11.0)
10005 FORMAT (2X,7F11.0)
10006 FORMAT (2X,F10.0,9X,F4.1)
10007 FORMAT (2X,7F11.0)
20002 1 FORMAT (//,CAP1,CDISB,CPRG,CINTRM,CPRELM,PROFIT ON
1 COST UNADJUSTED ROI PRICE,/) CONTRACT PRICE CASH FLOW & CONTRACTOR
1 INVESTMENT,/)
20005 1 FCRIAT (F13.2,5X,F13.2,F13.4,F12.2,10X,F10.4,26X,F10.4,/)
20006 1 FCRIAT (//,7X,DAY,5X,DISBURSEMENTS,5X,PROGRESS PAYMENTS,5X,
1 INTERIM PAYMT,6X,FINAL PAYMT,3X,OTHER FINANCING //,2X,CON
1 TRACTORS INVESTMENT,/)
20007 1 FCRIAT (F9.0,5F18.2,3X,2F15.2,/)
20008 1 FCRIAT (6X,5,17X,5,14X,5,10X,5,20X,5,35X,5,2,/)
20009 1 FCRIAT (8F11.0,/)

C
STOP
END

```

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